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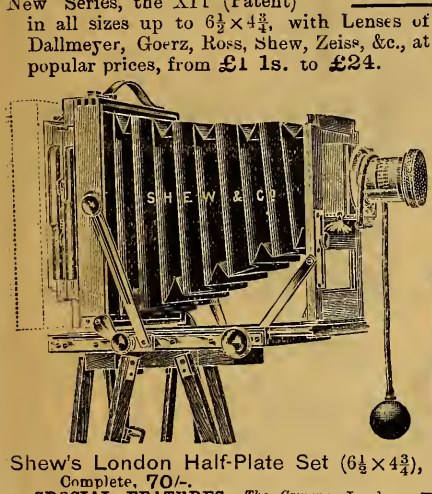

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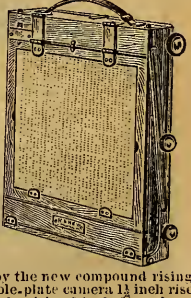

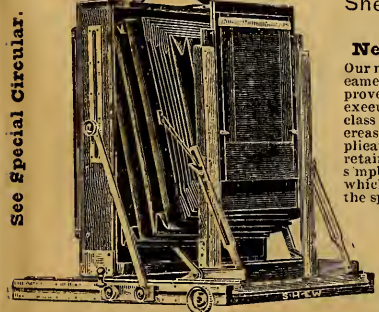

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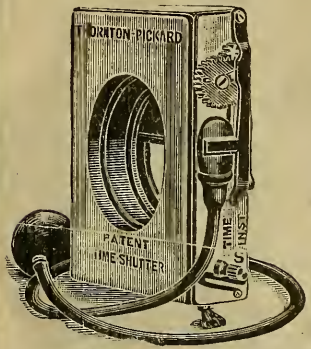

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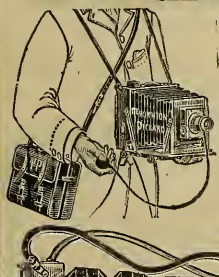

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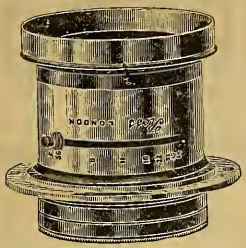

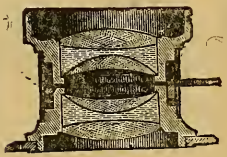

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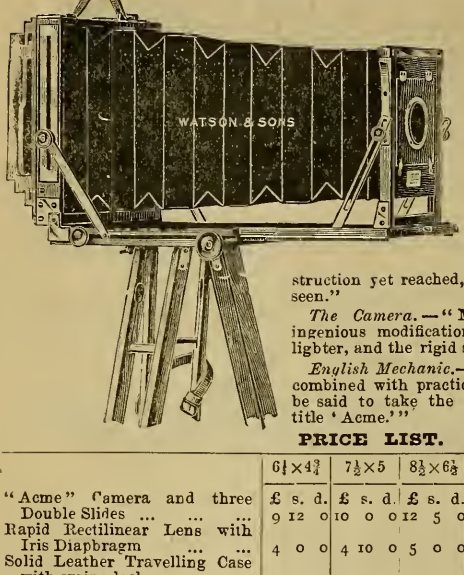

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PREFACE

TO THE

TWELFTH EDITION.

This Manual of Instructions for Beginners in Photo- was first published seventeen years ago as the A B C of Modern Photography. A certain firm of dealers in photographs and photographic goods objected to the use of the title, inasmuch as they had used a similar name for a pamphlet, which was, to all intents and purposes, merely a trade catalogue. I gave up the title, and issued the second edition with that which is now on the outside of the cover. The public has looked kindly on my attempt to teach the elements of photography, and ten editions with the present title have been issued, making, with the first "A B C" edition, the number of eleven sold.

That this kindly feeling for "Modern Photography" still exists is evinced by the fact that a revised edition

has been in demand for several years. Certainly revisal was necessary, for though it is only six years since the last revision, the advances in photography have been so great during that short time, that what amounts to nearly a re-writing was found necessary.

These advances are, so far as the beginner is concerned, in the matters of almost a revolution in photographic optics; of a number—almost confusingly great—of new developers, each having an advantage for some particular kind of work; and of improvements—or, at any rate, novelties—as regards printing papers and other surfaces for receiving positive photographs. These advances are described, and I have attempted, as before, to make everything as plain and simple as possible, without any attempt at ornamental writing.

Other advances have been made. Photography as an ART has advanced more in the last few years than in all others since it was invented. The same may be said of *process work*, which, not so long ago, was a sort of abortive curiosity; but now shows us, in nearly every illustrated publication we may take up, a reproduction of Nature as true as monochrome can render it, or the actual touch of the artist of pencil, pen, or brush.

Then there is Photography in Natural Colours proved a possibility, and actually occasionally put in practice so fairly well that we may live in hope of its being a thing accomplished in a few years; besides X-rays and animated photography, all which are beyond the scope of my present work, which is essentially intended to be a *beginner's* book.

Perhaps the greatest change that has come to the amateur towards the end of this nineteenth century is the way in which he has (for the necessary number of shekels) everything at hand, and any of his work that he dislikes, or is too lazy to do, done for him. Think of it, Reader: twenty years ago we were either up to our ears in collodion and that awful "silver bath," or were making our own dry plates! It needed an enthusiast then to make an amateur photographer.

Home Department, Tokyo, Japan, 1899.

PREFACE TO THE ELEVENTH EDITION.

It is but a short time since this little book was nearly entirely re-written, the changes in photographic practice having made such a course desirable. The writer thought at that time that at least several years would elapse before anything farther in the way of revision than the correction of a few errors that had slipped into the ninth edition would be needed. So rapid, however, are the advances of photography in these days that something more is necessary, and the whole work has been thoroughly revised. Additions have been made, and also here and there alterations that have been suggested by practice.

Imperial University, Tokyo, Japan.

CONTENTS.

BURTON'S
MODERN PHOTOGRAPHY.

INTRODUCTION.

I wish at the outset to explain my reason for writing this little book, and the object which throughout I shall attempt to bear in mind.

After Archer brought out his collodion process about the middle of the century, photography for the first time became a popular amusement with those who had a leaning to art or science, or both. The scientific interest and novelty attaching to the then comparatively new process, combined with a totally false idea of how easy it would be, by means of it, to make a "picture," attracted enormous numbers of those who had some spare time on their hands to take up the subject as amateurs. After a while, many of these found that their expectations were scarcely realised, and they found, too, to their surprise, that a mere transcript from nature was not neccssarily a picture, but that as much art-culture, if not as much skill, is needed to produce such when the tools are the camera and lens, as when they are the pencil and brush. They found, also, that the skill required was greater than they had supposed—that, at least, a slight knowledge of chemistry and of physics was necessary, or endless troubles would arise.

The realisation of these facts greatly thinned the ranks of the amateurs. Another era has, however, now arisen in photography—the era of the gelatine dry-plate process. The technical skill necessary to produce a photograph has been greatly reduced. The plate is now no longer prepared by bringing into contact, immediately before exposure, two fickle and uncertain chemical preparations—the "collodion" and the "bath"—but it may be purchased ready-made, will keep for any time, from several months up to several years, according to make, speed, and atmospheric conditions; may be exposed at any time; and there are, indeed, now many who will undertake all the work except that of selecting the subject, focussing, and exposing, and although I cannot help having a contempt for the "you press the button, we do the rest" man, woman, or child, there is no doubt that the system has its advantages, as one perfectly ignorant of photography may once in a way (by a lucky chance) get a valuable result that would otherwise be lost. True, artistic feeling is as necessary as ever; but that uncommon combination, a mind equally artistic and scientific, is required to a less degree than before, and wider scope is given to the former capacity.

The consequence of this is, that the number of amateurs has for the last fifteen to twenty years been enormously on the increase. The man who has but a few summer days to spare may take the camera, and may work it with profit. Indeed, it is now perhaps the exception rather than the rule *not* to work some kind of camera.

Now I come to the object of this little work. How is the dry-plate aspirant, who takes up the gelatine process as his first, to gain the necessary information to enable him to practise the art? If he has a photographic friend—if his friend and he have coincident spare hours, and if his friend has the ability of conveying to others the knowledge which he himself possesses

(an ability rarer than is generally supposed)—then the way whereby the would-be photographer is to gain his information is clear.

In very many cases, however, the beginner has no such friend; then, where is he to turn? True, there are several excellent manuals published on the gelatine process, but these are quite unsuited for beginners; they presuppose a general knowledge of photography—at least, of the "wet process."* Then there are the directions contained in the boxes of plates which the tyro will purchase. They also are excellent in their way, but they are necessarily laconic, and they as well as the manuals are addressed to those who already are not unacquainted with photographic processes. They constantly refer to the collodion process as a standard, and they use technical language which is unintelligible to the beginner. Let any experienced photographer whose eye this may happen to meet try to cast his mind back to the times when he was tediously wading through the beginning of whatever was the first photographic process

* It must be borne in mind that this was written substantially as it here stands in the beginning of 1882. At that time there did not, to my knowledge, exist any book in which the dry-plate process was treated as *the* process of the day, and, indeed, I remember that I had difficulty in persuading the Publishers that it had become, or would become, *the* process. In fact, I believe I did not persuade them, because "a man convinced against his will," &c., &c. The first edition then stood alone, and I think the second did too. Now there are many competitors; still, there seems to be a place for the pioneer. Two things I have consistently tried to adhere to—plainness of statement or explanation, and avoidance of any puffing, pushing, or illustrating of the goods of particular makers. This puffing feature disfigures the pages of many a book on photography otherwise useful. When such books, pamphlets, or "booklets" are honestly issued *as* advertisements, or given with sets of apparatus, no one has reason to complain; but they are often placed before the public in the doubtful guise of independent writings, and are thus misleading.

he worked. Can he remember when terms now so familiar to him, such as "detail in the shadows," "density in the high-lights," conveyed no idea to his mind? Perhaps he cannot; but such a time there certainly was for him, and now is for everyone who first attempts to solve the mystery of the language in which the modern dry-plate manuals and instructions in the plate-boxes are couched.

I know the case of many who have begun photography since gelatine became popular, and who, feeling the want which I have attempted to explain—of anything to guide them to a direct knowledge of the working of dry plates—have familiarised themselves with the more difficult wet process for the sole purpose of using it as a stepping-stone to the former. In speaking of the gelatine process as easier than the collodion, it must be understood that I do so on the assumption that the dry plates are purchased from the manufacturer, not made by the photographer himself. No beginner should attempt to make his own plates. He will find that he has quite enough to do to learn to work those that are made for him by others. In fact, I consider that the most experienced photographer who is wise will buy his plates, unless he takes an actual scientific interest in the manufacture. Dry plates can now be had so cheaply that he can scarcely expect to save money by making them. This, however, is a digression. To return to the subject. What I intend to do is to give instruction in the working of modern dry plates, addressed to the merest beginners. I shall use no technical terms, or only such as I have already explained, and shall assume no knowledge of any photographic process whatever.

My endeavour will be to give such instructions that those beginners who follow them carefully may, without any other assistance, after a little practice, be able to turn out, with a fair approach to certainty, technically perfect negatives on plates

purchased from any trustworthy maker, and to make prints from the negatives, so as to enable them to complete their pictures. I shall avoid theory altogether; nor do I intend to enter into the question of art. All I propose to do is to teach the A B C of the subject—the purely technical. To the higher branches of photography—the artistic—the aspirant must be guided mostly by his natural gifts; but he will find much to assist him in many advanced books on photography. In fact, my desire is to produce a manual of photography *for beginners*, on the assumption that the gelatine process is now *the* photographic negative process of the day.

I devote a chapter to the subject of lenses, and give a few very simple rules whereby the beginner may gain some idea of the exposure that will be needed in different circumstances, and certain tables which will, for most cases, do away with the necessity for any calculation even of the simplest kind. It is common in manuals for beginners to say that knowledge of the length of exposure can only be gained by experience. This is partly true, but not entirely. Some idea may be given of how long the cap should be kept off the lens in certain circumstances, and this, I believe, will greatly assist the beginner. The writer remembers how, when he began the study of photography, with no assistance but such as he could get from the handbooks, he sought in vain for at least some faint clue to the length of exposure, and to the factors regulating it. The subjects of enlarging and lantern-slide making will be briefly treated.

CHAPTER I.

SELECTION OF APPARATUS.

The first thing that the photographic beginner has to do, after he has made up his mind that he is going to take up the fascinating art, is to determine what size he will work—that is to say, how large his pictures are to be, and this quite apart from whether plates or films are to be worked, of which more presently. As a matter of course, he should begin work upon one of the smallest sizes he can buy, as the first few results are sure to be far from perfect, and the cheaper the plates spoiled the better. This does not, however, bind him to the smallest size. Most photographic cameras are made so that several different sizes will fit them, and after the first difficulties are over, the tyro is sure to aspire to the production of something larger than the well-known "card" or carte-de-visite.

In considering size to be worked, it must be borne in mind that the larger the plate or film, the greater the weight to be carried into the field, the greater the difficulty of manipulation, and the heavier the expense at every turn. This being the case, I suggest, as a good size, that known as "half-plate"; that is, a plate measuring 6½ inches by 4¾ inches. This allows of pictures being taken of the popular cabinet size, and the apparatus necessary can very easily be manipulated in the field. A somewhat larger size—say 7½ by 5, which gives a landscape of very

pretty size and shape—can easily be carried by an active man; but I think that, at any rate, nothing greater than "whole-plate," or 8½ inches by 6½ inches, should be attempted at first. The smallest size of plates commonly offered for sale is the "quarter-plate," measuring 4¼ inches by 3¼ inches, and, as has been said, the beginner should confine himself to this size till he has become somewhat familiar with the different operations involved in the taking of a negative. All this applies to the "hand-camera" as well as to the "stand camera," except that 6½ by 4¾ is rather an unusually large size for the former. I go at present on the assumption that a "stand camera" will be used at first. Of the "hand-camera" more hereafter.

Having decided the size, the next thing to consider is in what manner to purchase the apparatus; and here let me say emphatically that the only way in which to be *sure* of getting reliable photographic negatives is to go to a first-rate dealer and to purchase them new from him. There is a general idea in the mind of the non-photographic public, probably gained from seeing numbers of old cameras and lenses exposed for sale in pawnshops and such like, that great bargains are to be made in second-hand photographic apparatus, and that the beginner may "pick up" what he wants very cheaply by a little looking about. There can be no greater mistake. The experienced photographer may pick up a very cheap article; but the man without technical knowledge is almost sure, if he attempt to do the like, to find on his hands goods that will be useless to him when he has somewhat advanced in his art.*

Having thus advised the reader where to purchase his appa-

* This does not refer to those few respectable dealers who make the sale of second-hand photographic apparatus a special part of their business. The writer has found these reliable and generally very accommodating in effecting exchange of apparatus, and so forth.

ratus, there still remains the question, "How? Is it advisable to go in for a complete set, or to buy each article separately?" The beginner will be best advised in this matter by the state of his funds. The "sets" made up by most of the chief photographic dealers are most excellent and complete; but the sum charged for them is greater than many are willing to lay out at once. These may buy at first only such articles as are absolutely necessary, and may add to their store from time to time as they think fit. I give a list of the articles most necessary for working quarter-plates, and afterwards shall say a word on such of them as seem to call for special description :—

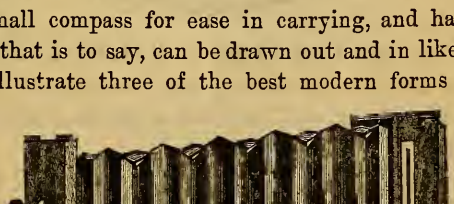
A camera.
A lens.
A tripod stand.
A focussing cloth.
3 flat dishes or trays of porcelain or other material.
Graduated measure holding ½-ounce.
Ditto, ditto, 4 ounces.
A dozen gelatine ¼-plates.
A darkroom lamp.
A cheap chemical balance.

The Camera.

The general form of the photographic tripod camera must be familiar to all. It consists essentially of a box, at one end of which is held a sensitive plate, whilst at the other is held a lens. An inverted image of any bright object which may be opposite the lens is thrown by it on to the sensitive plate. There is a means of adjusting the distance between the plate and the lens, or, as it is commonly expressed, of focussing. Every camera has, besides this, a piece of ground glass, which can be put in the exact place to be afterwards occupied by the plate, and upon which the image can be seen so as to facilitate focussing. It is also fitted with a "dark slide." This is a sort of case in which a sensitive plate may be fixed. After the camera has been focussed, the dark slide is placed in the position before occupied

by the ground glass, which latter is removable. The "shutter," or sliding door of the dark slide, is then removed, and, on taking the cap off the lens, or actuating an "instantaneous shutter," the image falls on the plate. As many dark slides as are wished may go with a camera, and thus a number of plates may be carried into the field. Slides are constructed to hold two plates each, and are called "double dark slides" or "double backs." These are by far the best and most convenient to use for dry plates. Three slides are a common number to go with a camera. This enables half a dozen plates to be carried out. Each dark slide should be fitted with a set of "carriers." These enable plates smaller than the largest size for which it is constructed to be placed in it.*

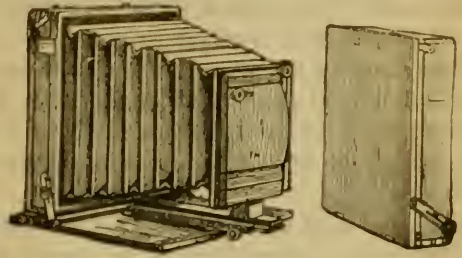
All modern cameras for use in the field are made so that they can fold up into small compass for ease in carrying, and have "bellows bodies," that is to say, can be drawn out and in like a concertina. We illustrate three of the best modern forms of



camera, showing in each the camera as in use, and as folded down for transportation. In purchasing a camera, the photographer should get one which will open to a considerable distance—if possible, to as much as twice or three times the length of the largest sized plate which it will work. In some part of

* See chapter which treats of sensitive films to take the place of glass plates.

his career the amateur is sure to aspire to the taking of portraits. His attempts in this direction are likely to be failures, and to cause great pain to his friends; but nothing is surer than that the portrait fit will attack him. When it comes to this, he will find a camera that opens to a considerable length a great advantage. Even apart from the matter of portraits, a camera opening

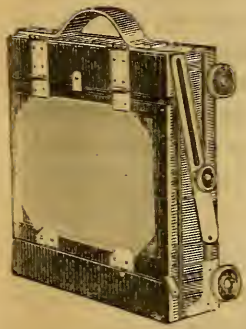


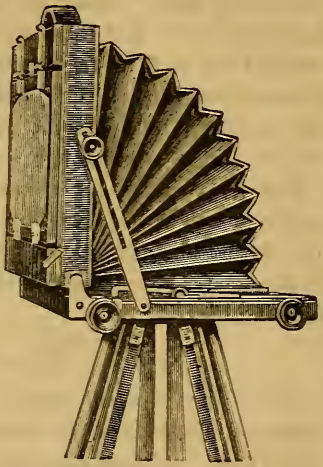
to a considerable length is desirable, as it is now becoming a generally recognised fact that more artistic pictures are got with lenses of comparatively long focus than with those of very short focus.*

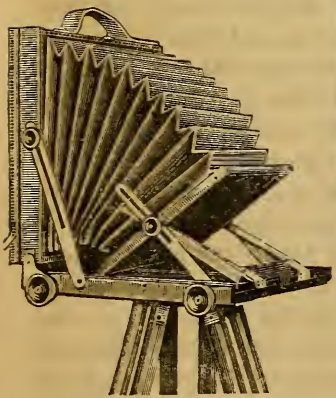
There are various adjustments attached to modern cameras which, although of little use in the hands of the beginner, will be found of great convenience to him when he is more advanced. These are chiefly a vertical and horizontal adjustment of the front on which the lens is screwed, what is called a "swing-back," which provides a means of varying to a certain extent the angle between the sensitive plate and the axis of the lens, by a method to be described in a subsequent chapter. A leather or stout canvas case, in which the camera and dark slides can fit, should be provided; and a "reversing" back, to make it easy to take either horizontal or vertical pictures. The "revolving" horizontal back is a particularly convenient form.

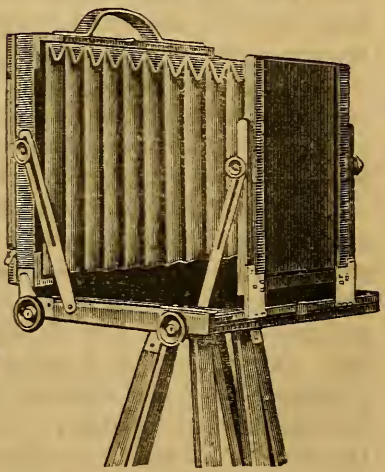
* See chapter on Photographic Optics.

Various attempts have been made to obviate the necessity of









having separate dark slides, and cameras have been constructed

so that they either contain a supply of plates themselves, appliances being added to enable these to be brought into position, or so that the plates are contained in a box from which they may be transmitted to the camera without the intervention of more than one dark slide. Some of these are by no means unsuccessful in practice, especially for small cameras—they are further mentioned under the heading of "Hand-Cameras"—but on the whole I incline to prefer double dark slides to any of them—at any rate, for stand camera work. In a future chapter I shall speak of the use of paper and films as substitutes for glass, and of the various appliances used for exposing them.

Hand-Cameras.

These first became popular by the name of "detective cameras," the idea of the inventors being that they would be much more useful in assisting in the detection of crime than a large experience has shown to prove at all likely. As applied to amateur work the name was objectionable, as giving the idea of a sort of *sneak* photography. Horrible names for hand-cameras have been invented in America and other places—nay, even verbs and adjectives have been evolved from them; but these words will not be allowed to defile these pages.

The *Hand-Camera* is just what its name implies. It is a camera to be held in the hand during exposure instead of on a stand, and, moreover, all good forms are so made that the camera can be brought to bear on any object that seems a likely one at a moment's notice, *after the user has had* the necessary practice. The exposure has in nearly all cases to be what is called "instantaneous"—for which see another chapter. The image is sighted on a "view-finder," which is generally somewhat of the nature of a miniature subsidiary camera, showing a minute image, though in some cases a double camera is used, the image

on the ground glass appearing as large as that which is thrown on the plate. There are often two finders, the one for horizontal, the other for vertical work. In any case, it is important that the finder should include the same quantity of "view," or subtend the same angle, as the image on the plate.

The hand-camera has so many advantages, and permits of so much work not possible with the stand camera, that it is at least a question which of the two the beginner should adopt. There is one common delusion of which, however, I hope the said beginner will rid his mind at once: this is that it is *so easy* to use a hand-camera. Let him understand from the beginning that *the use of the hand-camera involves all the difficulties of the use of the stand camera, and a special set of others peculiar to the former instrument.* In fact, it needs a *great deal of practice* to use the camera in the hand with even an approach to certainty of success, and this even in the case of one who has had long practice with the stand camera. The following by Mr. George A. Elder, in the American comic paper *Puck,* is very appropriate. Mr. Elder is describing his troubles on having been seized by the photographic "phrenzy":—"An instantaneous exposure, or snap shot, is made in bright sunlight* by aiming the camera at the object and pressing the button. This seems dead easy, but I can't do it. Probably Buffalo Bill would make nothing of shooting a train of cars or a circus waggon on the wing; but my marksmanship is not equal to it."

The general appearance of the hand-camera must be so familiar to all, that it is not worth the time or space either to describe or illustrate it here.

A Compromise: the Hand and Stand Camera.—Nearly all high-class hand-cameras, and even some that can by no means be called high-class, are fitted with one or two female screws

* Not of necessity.—W.K.B.

and a full-sized focussing glass, so that no more is necessary than the purchase of a tripod stand and a male screw, when the *hand*-camera may be used as a *stand* camera. The *two* female screws are to allow both horizontal and vertical pictures to be taken. The *hand and stand* camera is one of the most economical and useful for the beginner who is satisfied with a small size. It should have all the attributes of a stand camera, but neither a swing-back nor a reversing back is necessary, the camera, and not the back, being moved through an angle of 90° when necessary.

Even if a hand-camera without provision for tripod stand be purchased, it may be used with a table or other convenient support till the student becomes familiar with the purely photographic part of his work, provided that it is fitted for "time" exposures as well as for "instantaneous."

Size to be worked.—Hand-cameras have been brought to such perfection that with some of them really excellent negatives, such as will stand considerable enlargement, or will do for the direct making of lantern slides of a size as small as 3¼ by 3¼ inches, can be produced. Neither direct prints, enlargements, or lantern slides should, as a rule, be made of this square size, but it is generally possible to select a portion three inches—or nearly three inches—long for reproduction.

The most popular size is "quarter-plate," or 4¼ by 3¼ inches. I can thoroughly recommend this, or the next size larger that is commonly used—namely 5 by 4 inches—which is not too cumbersome to work in one hand. The largest size used by sane individuals is 6½ by 4¾ inches, but even this size presents very great difficulties, and is not to be recommended to any but experts.

Style of Hand and Stand Cameras, Films, Cost of Lenses, &c.—I have to stick here to my rule that I may not recommend the goods of any particular maker, and as the number of different

styles of hand-camera (most of them adjustable for stand work) is legion, I cannot even describe them here, but must be satisfied by specifying what I consider some essentials for stand and hand cameras, and making a broad classification of some types.

For hand work the first consideration is the greatest simplicity of manipulation that can be combined with efficiency. All motions to be made before the beginning of sighting should be easily under the control of the fingers of the two hands, preferably the thumb and first two fingers. After that one hand should suffice for everything but actuating the trigger or squeezing the pneumatic release. Adjustable diaphragms, means of altering the focus and of varying the exposure, are essentials for good work, whilst a rising front is a desideratum.

For *stand* work there should be long extension, to facilitate the taking of portraits and the means of making "time" exposures.

Hand-cameras may be classified as *dark-slide* cameras, *magazine* cameras, and *roller-slide* cameras. Indeed, this applies, within limitations, to all kinds of cameras.

The dark slide has already been described. It is very certain in its action, but is cumbersome (in sufficient number) as compared with either the magazine or the roller-slide, and it is less "ready." With the hand-camera six dark slides commonly go, so that a dozen plates are ready for exposure.

The *magazine*, whether used for plates or films, is comparatively compact, and is very "ready"; but at any rate a great number of these in the market are liable to jam or fail to act at a critical moment. In a magazine the plates or films are brought into position in succession by mechanical arrangements which can be actuated from outside the camera, or sometimes by the hand working from the outside of an opaque leather bag, or by both.

In the *roll-holder* the sensitive surface is supported on a film

so thin that it can be rolled in the plane of the image from one roller to another, one at each end of the holder, after the manner of a diorama. These films are treated in the chapter on Flexible Supports.

Another classification of hand-cameras is into *plate* cameras, *cut-film* cameras, and *rolled-film* cameras. The two last will be treated in the chapter on Flexible Supports. It is enough to say of them here that whatever is said of the appropriateness of films for photographic work especially applies to the case of hand-cameras.

All that has been or will be said of lenses for stand work applies to hand work, with the addition that rapidity is of higher importance in the latter than in the former case. The "single achromatic" is not rapid enough for all-round hand-camera work; indeed, the "single anastigmatic" is scarcely quick enough. The "rapid rectilinear" is about the slowest lens that should be used. Most high-class hand-cameras are made so that any of several different makes of lenses can be fitted, and the dealer gives an option to the purchaser, the total cost varying, of course, with the price of the lens selected.

The *price* of a new hand-camera may be anything from a few shillings upwards. A quarter-plate hand and stand camera may cost up to £40, and this without a penny being spent on "frills," all the money going on perfection of workmanship and on refinements, each one of which enables the camera to do something it could not otherwise do. Such a price is, however, extravagant, and it may be a consolation to know that high-class work can be done by hand-cameras costing not more than £3 or £4. As to the very cheap hand-cameras so much advertised—generally by horrible names—it can only be said that technically high-class work is not to be expected of them, but that they are not to be totally condemned, as the results may serve to awaken pleasant reminiscences, or may be useful as a

basis for illustrations in magazines, &c. In any case, they are fairly harmless and often instructive toys in the hands of the young. A boy is not likely to do so much harm to himself or to others as he may with any cheap form of "shooting iron."

It is to be observed that hand-cameras are usually sold complete and ready for use, whilst with stand cameras the matters of the camera itself, and of the lens, &c., are separate affairs.

The Lens.

Next in importance to the camera—if, in fact, it is not more important—comes the LENS. As it is intended to devote a special chapter to lenses, I shall not go much into the question just now, but shall merely say that, for all-round work, a very useful forms of lens is that sold as "*rapid rectilinear*," "*rapid symmetrical*," &c. (a still better, though much more expensive in most cases, is one of the still rapider NEW LENSES, sold as "anastigmatics," "stigmatics," &c., which will be treated in the proper place), with an aperture one-eighth part the focal length. Whichever is adopted, the focal length should be from $1\frac{1}{3}$ to $1\frac{1}{2}$ the length of the largest plate to be worked, whatever the catalogue may say about the covering power of the lens (see chapter on Lenses). A cheaper and very useful lens, though not so rapid, is one of the "*single achromatics*" of modern design. A vast improvement is the *single anastigmatic* of the *new lenses*. It is more expensive than the single achromatic, but is rapider, and has other advantages, to be described in the chapter on Lenses. Of either the single achromatic or the single anastigmatic the same is to be observed of it in the matter of focal length as of the rapid lens. The "wide-angle" landscape lens mentioned in former editions of this book is an excellent one for special work, but is not to be recommended for all-round work unless of a focal length to cover a plate several sizes larger than that actually used with it.

The *tripod-stand* calls for little special remark. Its general form is known to all. In stands of modern construction each leg folds into two, or sometimes into three, so as to make the whole more portable, and in some cases each leg has a sliding adjustment. The chief requirements of the camera-stand are that it should be light, be easy to fit up and take down, and should be rigid when fixed up.

The *focussing-cloth* is intended to cover the head and ground glass, thereby shutting out extraneous light, and making it possible to see the image given by the lens sufficiently distinctly to adjust the focus. It should be about four feet square for small-sized cameras. Velvet or velveteen is the most commonly used material, but any black and opaque cloth will do. For work in the sun in very hot weather—always in the tropics—there is an advantage in a cloth with a white outer side and a black inner.

The flat dishes or trays—or, as they are sometimes called, flat baths—are for use in the operations of developing, fixing, &c., to be described in a future chapter. Such dishes, made of so-called porcelain, can be had for a few pence each, and I recommend that these be purchased for quarter-plate work. When the photographer advances to larger sizes, he may indulge in the more expensive and more convenient dishes made of ebonite, celluloid, or other light material.

The dry plates or films can be bought from any photographic dealer. They are extensively advertised in the photographic periodicals; but I cannot take upon myself to recommend one make in preference to another. I have found almost all excellent, the cheap as well as the more expensive, if not too old, and given fair treatment. Out of almost numberless brands, there are very many each having its own particular merit. What we want to see is the plate or film that combines all the merits and good qualities of all these brands.

The dark-room lamp will be described when we come to the chapter on the "Dark-Room."

The most convenient balance for photographic use is such a one as druggists weigh out their chemicals in; but a small pair of scales without stand, such as is sold for about half-a-crown, will do well. For practical photography, weighing apparatus of great delicacy is by no means necessary. A set of grain and drachm weights are needed. The system known as "Apothecaries' weight" has been adopted throughout this book, because it is that most generally used for practical chemical and photographic work in this country. But it is unnecessary to say that the French decimal system is vastly superior. For this reason, in the case of all formulæ a corresponding formula in French decimal measures and weights is given in a foot-note in the present edition. It has not been attempted to make these correspond exactly with the English weights and measures. It would involve many odd figures, and often many decimals, to do so; and, as photographic formulæ are generally very elastic, it is considered that it is likely to be of more convenience in practice to give formulæ that are practically correct and that are in round figures, than to exactly reproduce the proportions given in the English formulæ.

CHAPTER II.

CHEMICALS.

After the photographer has provided himself with the necessary apparatus and plates, his first consideration must be the purchase of the chemicals which he will require to convert his plates into negatives. A list is given of those which he will need to begin with, stating after each about the quantity which I think he may well possess himself of at first. Afterwards are given a few words describing the general properties of each substance, but not entering into the chemical composition. Each chemical, whether liquid or solid, should be kept in a bottle, which should have the name distinctly labelled upon it—if possible in print.

The chemicals required are as follows:—

Pyrogallic acid	1	ounce
Ammonia of specific gravity ·880	3 or 4	ounces
Carbonate of potash	1	pound
Sulphite of soda	1	,,
Bromide of ammonium	1	ounce
Bromide of potassium	1	,,
Citric acid	1	,,
Hyposulphite of soda	1	pound
Alum	½	,,
Methylated spirit	½	pint
Bichloride of mercury	1	ounce
Negative varnish	A few	ounces

A couple of books of test papers, one of blue litmus and one of red litmus.

Pyrogallic Acid is a white, feathery, and extremely light body. It is exceedingly soluble in water. It is a powerful absorber of oxygen, especially when alkaline. When a solution of it has absorbed oxygen it turns brown, or even very nearly black, and stains the fingers or nearly anything else that it comes in contact with.

The *Ammonia* used in photography is the strongest solution of ammonia gas in which it is possible to make water at atmospheric pressure, and has, or is supposed to have, a specific gravity of ·88. Ammonia is the well-known hartshorn. It is a transparent and colourless fluid, is powerfully alkaline, and has a most pungent and characteristic smell. When the stock has been purchased, it is advisable to pour it at once into a bottle holding exactly double the amount of the ammonia, and to fill up the bottle with water. If this is not done, the stopper of the smaller bottle may be blown out by the pressure of the liberated ammonia gas when the weather is warm. This will destroy the whole, as, on exposure to air, the liquor ammonia rapidly becomes weaker, because the ammonia gas escapes.

Carbonate of Potash is in the form of a heavy white powder, or of very small white crystals. It is deliquescent, and the bottle containing it should be kept well corked or stoppered, otherwise the potash is liable to absorb much moisture. It is very readily soluble in water.

Sulphite of Soda is in the form of irregular white crystals. It is liable, on exposure to the air, to become oxidised into sulphate of soda, in which form it is useless for the purpose for which it is intended in photography. The bottle containing it should, therefore, be kept tightly corked or stoppered. The crystals should be clear and transparent. If they are covered with a

white powdery deposit it is likely that the sulphite has been partly oxidised. Sulphite of soda is readily soluble in water.

Bromide of Ammonium is usually found as a white powder, looking very much like ordinary table salt. It is readily soluble in water.

Bromide of Potassium is in large, pure white, laminated crystals. It can be used instead of bromide of ammonium in all cases, increasing the quantity about 60 per cent. It is considered by many to have advantages over the ammonia salt, except when the developer is the "ammonia developer."

Citric Acid is met with either as clear, colourless, crystals, or as a powder. It is soluble in water, but slowly.

Hyposulphite of Soda is a clear, colourless crystalline body, slightly deliquescent. It is readily soluble in water.

The Alum used may be the ordinary alum sold by grocers. As it is intended to be dissolved in water, it should be bought in the form of a powder. It does not dissolve in very large quantities in cold water, and then somewhat slowly. It dissolves readily in hot water when it is in the form of powder.

Methylated Spirit calls for no particular notice, as it is well known to all. That sold as "finish" is not suitable for photographic purposes.

Bichloride of Mercury is a whitish crystalline substance. It is sparingly soluble in water, and is an active poison. It is commonly known as corrosive sublimate.

Negative Varnish in appearance is like the ordinary spirit varnish used for varnishing wood, but generally differs from it in the resin used in its manufacture. It can be bought from any photographic dealer. That sold as "dry plate negative varnish" is the most suitable.

The Test-Papers are for discovering whether a liquid, such as a solution of any salt, is neutral, acid, or alkaline. To use them, we proceed as follows:—Suppose we have a solution of

whose condition as regards acidity or alkalinity we are ignorant. A small piece of the blue litmus paper is dipped into the solution. If the paper change its colour to red at once, or after a short time, the solution is acid; if no change in its colour take place, the solution is either neutral or alkaline. In this latter case a piece of the red litmus paper is dipped into it; we now know its exact condition. If the red litmus become blue, the solution is alkaline; if no change take place, it is neutral.

I have now enumerated and shortly described the necessary chemicals for *beginning* photography, and shall give instructions for mixing a few of what are called "stock solutions." These are solutions which may be kept for some time, and that the photographer should have by him. The ones described are those to be used in the first lesson in development.

Stock Solution.

No. 1 bottle to be labelled "*Ten per cent. Solution of Pyrogallic Acid,*" in large letters, so that it may be read in a dull light. We take four ounces of sulphite of soda, and one dram of citric acid, and add warm water with much stirring, till the whole measures about nine ounces, continuing the stirring till the crystals are quite dissolved. We then pour the solution over the pyrogallic acid in a fresh one-ounce bottle. The pyro will dissolve instantly. We then make the whole quantity up to ten ounces.* This may be looked upon as a ten per cent. solution of pyrogallic acid merely, the only function of the other chemicals being to prevent the spontaneous oxidation of this substance, and the consequent deterioration of the solution.

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* Sulphite of soda ... ... 120 grammes
Citric acid ... ... 4 „
Pyrogallic acid ... ... 30 „
Water enough to make up to ... ... 300 c.c.

No. 2. *Ten per cent. Solution of Carbonate of Potash.*—This is made simply by placing one ounce of carbonate of potash in a measure, filling up with cold water, and stirring with a glass rod till the salt is melted.* For this carbonate of potash solution there may be substituted one of carbonate of soda, using one ounce of good washing soda instead of the same quantity of carbonate of potash. Of this soda solution about twice as much has to be used as of the potash solution. The result is a slower developer, but one which is more under control, especially in hot weather.

No. 3. *Alum Solution.*—Three or four ounces of the alum are placed in a pint bottle. This is filled up with warm water. The whole of the alum will probably dissolve, but some of it will be thrown down again as crystals when the solution becomes cold. As long as these last, more water may be added from time to time, as the solution is used. When they are all dissolved more alum must be added.

No. 4. *Fixing Solution.*—Five ounces of hyposulphite of soda or "hypo" are placed in a pint bottle, which is filled up with warm water, and shaken till all is dissolved.

Common tap-water may be used for all these solutions, which, stated briefly, are as follows :—

No. 1. Ten per cent. solution of pyrogallic acid.
No. 2. Ten per cent. solution of carbonate of potash.
No. 3. Saturated solution of alum.
No. 4. Twenty-five per cent. solution of "hypo."

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* Carbonate of potash ... ... 50 grammes
Water sufficient to make up to ... ... 500 c.c.

CHAPTER III.

THE DARK-ROOM.

The reader will understand that the plates which he is about to work with are of the most "exalted sensitiveness"; that is to say, a very small amount of light allowed to act on them will produce a change that may be made visible. It must be explained, however, that only certain rays of light have much power to make the change here mentioned. All readers who have a little knowledge of physical science know that white light is in reality a combination of light of all the beautiful colours we see in the rainbow, and that if we pass a ray of white light through a prism, it will be broken up into all these. The order of them is:—Violet, indigo, blue, green, yellow, orange, and red. Those at the beginning of the list are called rays of high refrangibility; those at the end, rays of low refrangibility. Now, it is a curious fact that the photographic change which is worked on the ordinary sensitive plate is brought about almost entirely by the rays of high refrangibility, principally by the violet and blue, and certain invisible rays even more refrangible than these, which are said to be "actinic"; whilst the red, which is said to be "non-actinic," has no appreciable effect. Were it not for this peculiar fact photography would be almost impossible, because we could find no light in which we could manipulate our plates without

their being affected, and consequently destroyed. As it is, however, we only need to secure some place illuminated by those rays that have very little photographic action, and we can work with tolerable freedom. In other words, we want a room lighted with only red, orange, or yellow light in which to work.

It was at one time supposed that the modern sensitive dry plates could not be worked but in the deepest of ruby light. Thanks, however, to Mr. W. E. Debenham, we now know that it is quite as safe to work in orange, or even yellow light, as in ruby; that, indeed, if the proper shade of yellow be got, it is probable that more visual light may safely be admitted than when the colour is ruby.

Photographers give a room lighted with only non-actinic light the name of "dark-room," although the term is a misnomer. On the "dark-room," then, I propose to give what hints I consider necessary for the beginner.

It is scarcely to be expected that the young amateur, taking up the subject of photography for the first time, will be able to obtain the exclusive use of a room of considerable size to convert into a dark-room; he will probably have to put up with some temporary arrangement; nor is it at all necessary, even when he advances considerably, that he should have a permanent dark-room, unless he intends to make his own plates. Any room or closet from which all rays of white light can be shut off may be converted into a dark-room, in which plates may be changed and developed. If a room having a sink and water-tap—if, say, the pantry—can be "annexed" for the time being, the trouble will be greatly reduced; but it is quite possible to make shift with a pail for a sink, and a water-jug instead of a tap.

I have said that it is necessary to shut out entirely all daylight. This presupposes the use of artificial light for illumin-

ating the apartment with the necessary red or non-actinic light. I think that until such time as the student sees his way to fitting up a permanent dark-room, he will find it best to work with artificial light.

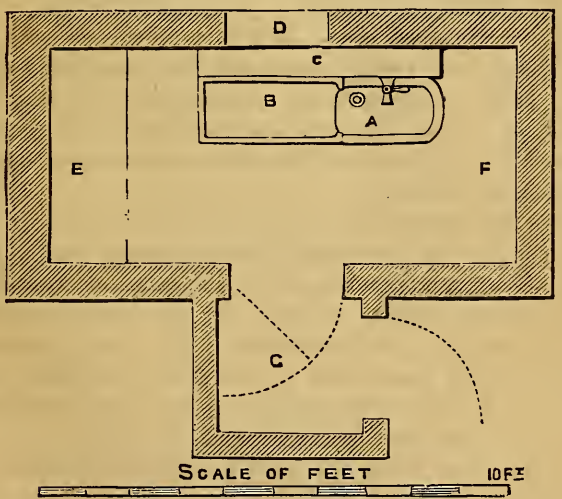
Lamps constructed especially for the purpose of giving "safe light" are sold by all dealers in photographic apparatus. These use either gas, oil, or candles, and all consist of an arrangement whereby the air necessary to support combustion is introduced by passages which will not allow white light to find its way out, the colour of the light being modified by funnels or globes or plates of ruby glass, or shades of ruby, orange, or yellow paper or cloth. The gas and oil lamps are much to be preferred to the candle arrangements, as with the former it is possible to raise or lower the light at will.

All, then, that the photographer has to do is to find some small room or closet, which he can make quite dark, in which he can have a plain deal table to work upon, and to purchase a "dark-room lamp" from a photographic apparatus dealer. The description of dark rooms will not, however, be complete unless something is said about the fitting-up of a permanent photographic room, in which all the operations, including the manufacture of plates, may be conducted. On page 29 is given a sketch of such a room; but before giving some details about it, I think it well to say a word or two on the actual amount of light admissible to the dark-room. If the plates that we had to use were absolutely insensitive to red, orange, and yellow light, and if there were no difficulty in selecting coloured mediums that passed only the light of one part of the spectrum, there would be no difficulty in arranging a so-called "dark-room" that might, nevertheless, have an indefinite amount of a certain coloured light; but the two facts come in, that modern dry plates are more or less sensitive to light of all parts of the spectrum, so that, even if we could select a light

representing only a very limited part thereof, we would find it practically impossible to have an absolutely safe light; and there is also the almost insurmountable difficulty of getting a light that represents only a very limited part of the spectrum. The outcome of all this is, that there is no such thing as an absolutely safe light, and that we should, in all work with dry plates, use no more light than is necessary to enable us thoroughly to see what we are doing. It is quite possible, however, to have a practically safe light that may be quite comfortable to work by *when our eyes are accustomed to it;* but I would point out to all who are working in the dark-room for the first time that there is an enormous difference in the estimate that we make of the strength of a light, according to whether we come on it first from a brighter or a less bright light. To give an example: If we come from brilliant sunlight into a dark-room that is properly lighted, we see nothing but the lamp or lamps, and these but dimly. If, however, we come into the same room after having been in the dark, of an evening, for an hour or two, it will appear so bright that one can scarcely believe that it is the same room as was seen before lighted in the same way; every article in it is distinctly visible, and it may even be possible to read a newspaper in it. This is partly due to the contraction of the retina in the bright light, and the expansion in dark, but is much more due to the great loss of sensitiveness that the retina suffers in very bright light. After coming from bright sunlight into a dark-room, it takes from a quarter of an hour to twenty minutes for the full sensitiveness of the retina to be regained, and any estimate of the light used for development up to that time is likely to be an under-estimate. Probably few people have gone more frequently in and out of dark-rooms than I myself have, yet it never ceases to astonish me, the extraordinary apparent increase in the light of a dark-room that takes place within about a

quarter of an hour of entering it from a very bright light, and even yet I can sometimes scarcely believe that the increase is only apparent. It will be understood then that, if we select the right colour, we can have enough light to be able to see quite easily at those times when the sensitiveness of the retina is at the maximum, but that no light can be safe that will enable us to see at all easily immediately after coming from a very bright light into the dark-room.

To return, however, to our sketch:



D is a window whereby the necessary light is introduced. It should be about two feet long by one foot six inches high. It may be glazed in any of several ways.

The following will be found to give a good and, at the same time, a safe (as qualified above) light. A sheet of orange-stained glass is used, and between this and the operator a sheet of "canary medium"—a light yellow paper—is fixed. A

movable screen of orange paper should be so arranged that it may be brought down to cover the window when the light is very intense, or when the process of plate manufacture goes on. It greatly facilitates working if a movable shade be so arranged that it may be brought between the window and the eyes of the operator whilst still letting the light fall on the plate, and permitting the operator to see the latter.

A is a sink made of glazed stoneware. The top edge should be about two feet six inches, or two feet eight inches, above the floor.

B is the operating table. It should be covered with sheet lead, should have a very narrow and low ridge round all the sides except that next to the sink, should have a very slight inclination in that direction, and should have the sheet lead "dressed" over the edge of the sink, so that all spillings may find their way into it.

C is a narrow shelf about four inches above the level of the table and sink, and extending along the whole length of both of them. On it may be placed the lamp when artificial light is used, as when working at night, and the bottles of solutions actually used for the development. The lower edge of the window should be an inch or two above this shelf. There should be a shelf about six inches below the operating-table, on which the flat developing dishes may be kept.

E is a table on which the levelling slab may be placed when the manufacture of the plates is begun. Above it—or, in fact, along all available space of the walls—shelves may be fixed for carrying bottles, &c.

A space is reserved at F for the drying-cupboard, used in manufacturing plates. Above this latter, and with its lowest edge about three feet higher than the floor, should be fixed an ordinary cupboard, with a door closing light-tight. In this may be placed plates or anything sensitive to light, which

would be destroyed if left about; for, as has already been explained, any kind of light will in time act upon the sensitive plate.

G is an arrangement of double doors whereby the photographer may go out or in without letting any light enter. If there be not space for this arrangement, one door may be used, with an opaque curtain a foot wider than this door hung outside it.

Provision must be made for ventilating the room without letting in light. There should be at least one common gas jet, for lighting up the room when no sensitive plates are about, so that solutions, &c., may be mixed with comfort, and there should be provision made for attaching several rubber tubes with the gas-pipes for connecting with Bunsen burners, &c.

The photographer will in all probability not *build* a room, but will adapt one already built to his purposes. In this case he will have to exert his ingenuity to allot his space to the best advantage. I have enumerated all the appliances for which room ought to be reserved.

CHAPTER IV.

EXPOSURE OF THE PLATE.

Before giving instructions in the actual manipulations of developing a plate, it is right to define the terms negative, exposure, and development.

A negative may be said to be a pictorial representation which, on looking through it at a bright light, shows all the shades, which are seen in any represented object, reversed. Thus, when we look through a negative of a landscape, holding it between us and (say) a gas-light, we see the sky and all objects which are in reality brightest, represented as black; whilst the darker parts of the landscape are represented by the bare and transparent glass. If the negative be a portrait, we see the face black, looking like a negro's, whilst a black coat looks white, and so on. The negative is produced by the action of light in the camera, the places where the light has acted most strongly being turned black. The time during which it is necessary for the light to act on the plate to produce the required effect is called the exposure. Now, it has been explained that the light acts upon the plate and darkens certain portions of it, but it must be understood that this action is not at first visible. A marvellously short exposure is sufficient to impress on a plate all the details of a landscape in such a manner that, by afterwards acting upon the plate with certain chemicals,

these details may be made visible. This operation is called development, and consists essentially in the increasing of the strength of a negative so faint as to be invisible to the eye, till it becomes as vigorous as we wish. Anyone, however unconversant with photographic operations, will see that when once we have obtained a reverse picture such as we have described, we have nothing to do but to place this in contact with a sensitive film and allow light to act through the negative, when we shall get a picture with its shades true to nature. The latter process is usually gone through with sensitive paper, and is termed printing.

Upon correct exposure and development nine-tenths of the technical success of negative-making depends; and when once the student has thoroughly mastered the relation of the one to the other, half the battle will be over. He cannot do so without practice, but I hope to give him such assistance in explaining the matter as may lead him to the desired end as quickly as possible.

Let the beginner select an object upon which he will make his first attempt. If he can resist the temptation to try a portrait, so much the better. A brightly-lighted landscape, with strong contrasts of light and shade, is the best; it need not be picturesque. A suitable view can generally be got out of some window, or a very suitable subject is a bust or statue placed either in a well-lighted room or out of doors. We shall suppose, in the present instance, that the landscape is selected. The camera should point neither towards nor away from the sun. If the sun shine direct into the lens, the plate would be destroyed; if the sun be directly at the back of the camera, the picture will look "flat."

Before beginning operations, I wish to explain what is the meaning of correct exposure. Let the student look attentively at the view which he has selected to make his first attempt

upon. He will see that, apart from the various colours represented, there is a very great variety of light and shade. He knows that this range is brought about by the fact that different objects reflect different amounts of light to his eye. Probably the sky will reflect the most light, and going through the whole range from this, he will see that there are a few little bits of the landscape that appear absolutely black. They do reflect some light, but it is so little that, by contrast with the brighter objects, they appear to reflect none. Now let the student consider the process that goes on during exposure. He knows that when he has his camera with a dry plate in position, and when he has removed the cap of the lens, a perfect picture of the landscape, with all the shades of light, will be thrown on the sensitive film, and that the light will be acting upon it. It is evident the brighter parts of the picture will first take effect, and afterwards the darker, until the exposure has been prolonged to such a period that all the shades of light, except those which, as we explained, appear in the landscape absolutely black, will have impressed themselves. At this point the correct exposure has been given. Had a shorter time been allowed, some of the darker shades—or, as they are technically called, the detail in the shadows—would have failed to impress themselves, and the resulting negative would have been said to be under-exposed. On the other hand, had the exposure been prolonged, the light emanating from the apparently black parts of the landscape would have impressed the plate, which would eventually appear to be darkened all over, and would be said to be fogged from over-exposure. It is said of a correctly-exposed negative that it shows all the details in the shadows without being fogged; if it be correctly developed, there is added to this a just gradation of density.

Now we pass on to the practical exposure of a plate, and I shall endeavour to show the student how he can tell, by the

behaviour of the plate during development, whether he has hit the much-desired correct exposure or not.

He will need to light his dark-room lamp, and to get by him the three flat dishes, the two measuring glasses, all the stock solutions for the mixing of which directions were given in a former chapter, and his box of dry plates.

Now he places his camera in position, opposite the view to be photographed; he removes the cap from the lens, and places his head under the focussing-cloth. He removes all stops from the lens, if it has movable stops, or, if the stops be rotary, turns them till the largest one is in use. This will make the image on the ground glass comparatively bright, and, by turning the focussing-screw first one way, then the other, he will easily find in what position the image is the sharpest. When he has discovered this, he places the smallest stop in the lens. I say the smallest stop, not because it is necessarily the best for the picture which he is going to take, but because it will enable him to give a comparatively long exposure, which is a convenience—at first at least.

Having his camera fixed and focussed, let him place the cap on the lens once more, and retire to the dark-room to fill a slide.

When once here, he places the dark slide* open in front of the lamp. Now he lowers the light till there is only just enough to enable him to see distinctly.† He opens his plate-box and takes out two plates—two glasses must be placed in the dark slide at once, but one may be a "dummy" if he happen to have but one dry plate, that is, either a clean plate of glass or a

* The procedure here described applies especially to dark slides for holding plates, but, speaking generally, these remarks are equally applicable to roll-holders or magazines.

† Note what was said in the last chapter about the effect of coming from a bright light into the dark-room. It will generally be found best to place the plate in the slide *before* going out to focus.

spoilt negative. In placing the plates in the slide, he must be very careful that in each case the side of the plate which appears dull, on account of its having the sensitive film on it, is placed towards the outside. Now, having closed his dark slide and wrapped his plates up again, the photographer returns to the camera. He should carry the dark slide under the focussing cloth, for additional security against light; and in placing the slide in the camera and during exposure should keep the whole apparatus, with the exception of the lens, under the cloth for the same reason. He removes the focussing screen, and places the dark slide in the position occupied by it, keeping the side marked "1" towards the lens. He now withdraws the sliding door, which is the only thing intervening between the lens and the sensitive plate. He takes his watch in his hand, and removes the cap from the lens for (say) five seconds, replaces it, slides in the shutter of the dark slide, and carries the latter off to the dark room. I have supposed any of the usual view lenses to be used, the landscape to be brightly lighted, the time of year to be spring or summer, the time of day morning or noon, and the plates to be of "ordinary" rapidity.

CHAPTER V.

FIRST LESSON IN DEVELOPMENT.

In the last chapter the photographer was left at that stage where he had accomplished the exposure of a plate, and was about to begin the development. It should be explained that the developer with which he is going to make his first experiment is that known as "alkaline pyro."

In the earlier editions of this book, I advised the beginner to make his first experiments in development with "ferrous oxalate," on account of its comparative simplicity. I now, however, consider that, on account of the introduction of sulphite of soda and alkaline carbonates in connection with pyrogallic acid, what is known as the "alkaline developer" is the simplest of any. A description of ferrous oxalate development will be given in a future chapter.

The photographer has now, let us suppose, returned to his dark-room. He may lay his dark slide, still wrapped in the cloth, on a shelf, and, turning up the white light, make the following preparations. He lays the three flat dishes in a row along the front edge of the table, the one to the left opposite the red or yellow light, the others to the right of this one. I shall call the dishes Nos. 1, 2, and 3, beginning at the left. Into No. 2 he pours two or three ounces of the alum solution; into No. 3

about the same quantity of the "fixing" or "hyposulphite" solution. Now he takes the four-ounce measuring glass, and measures into it, using the small graduate, 40 to 50 minims of the ten per cent. solution of pyrogallic acid, and about 100 minims of ten per cent. solution of carbonate of potash. He then pours water into the measuring glass up to 2 ounces.* This is now the developer ready for use. Two ounces is perhaps a somewhat extravagant amount to use for a quarter-plate, and, after some practice has been gained, it may be somewhat reduced, but at first it is best to use a good dose. Everything is now ready. The white light must be entirely extinguished, and the red or yellow light lowered as much as possible, till there is just enough to see by. The plate which has been exposed must be carefully removed from the dark slide, and laid —film side upwards—in dish No. 1, which is still empty. Now the dish with the plate in it is taken in the left hand, and the measure with the developer in the right. The developer is poured rapidly, but gently, over the plate, the dish being waved or rocked to make the liquid cover any corner which it may incline to avoid, and the whole is placed again in front of the red light, where it is kept in constant gentle motion. And now (if everything has been rightly done) will begin one of the most wonderful of the phenomena of science or nature which man has been given the power to control—a phenomenon which is always new and always beautiful—the "development of the latent image." Let the beginner watch it closely. The plate has no indication of having been acted upon at all before the developer is poured over it. After, perhaps, twenty or thirty seconds there is a slight darkening of some part. When this

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* Ten per cent. solution of pyrogallic acid ... ... 3 c.c.
Ten per cent. solution of carbonate of potash ... 7 c.c.
Water sufficient to make the whole quantity up to... 60 c.c.

becomes distinctly visible the light may be somewhat raised, for the plate has become less easily affected by it.* It will now probably be seen that the brighter parts of the landscape have become quite visible—in *negative*, be it remembered; the sky will be represented by blackness. Now is the time when we can tell whether or not the exposure has been correct. If it has been, the development will progress with beautiful regularity.

The bright parts (or high-lights) appear first; then slowly, but steadily, more and more of the half-tones, or less brightly-lighted parts come out; and at last every object and shade except the deepest shadows have their counterpart in the negative. In other words, the plate should be darkened to a greater or less extent in all parts except those few which represent the part of the landscape which appears to the eye quite black; and this should come about within a few minutes. If the plate have been under-exposed, it will be longer before the high-lights appear, and soon after they do the action will stop, no more detail coming out, but large patches of the plate remaining white as before. If, on the other hand, it has been over-exposed, the high-lights will appear a little sooner, and almost immediately afterwards the whole of the plate will be covered with detail, no part remaining white.

The final result of incorrect exposure is, with under-exposure,

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* All this intense care about the light used is not absolutely necessary after a little experience has been gained. Most experienced photographers prefer to work with a light sufficiently bright to enable them to see quite easily after they have become accustomed to the gloom of the dark-room, but keep the developing tray protected by a light wooden or cardboard cover, raising this for a second or two at a time only to observe the progress of development; but it is advisable that the beginner, to gain experience, watch the whole process of development, and if this is done, great care must be taken to keep the light as low as will still allow the plate to be distinctly seen.

a hard picture with contrasts over-marked, and with deep, heavy shadows, in which none of the detail which is visible to the eye is represented; with over-exposure, a flat, uninteresting looking production, showing all the detail which there is in the original, but lacking bold contrast of light and shade.

Let us suppose the happy medium to have been hit, if not at the first attempt, after a few plates have been exposed. The development is not of necessity finished when, looking on the surface of the plate, all action seems to have ceased. We have still, as a rule, to wait till the "*density*" is sufficient.

A little reflection on the principles involved in the process of printing, which was briefly described in a former chapter, will show that not only is it necessary, for the production of a harmonious picture, to have all the details which are in the original represented, but in the negatives these must be represented by a certain definite amount of opacity—or, as it is usually called, density. It must be understood, then, that as long as the plate lies in the developer, even after, when looking down upon it, all action seems to have stopped, the density continues to increase. We may say at once that the most difficult thing of all to judge of in gelatine dry plate work is when the required density is gained. So difficult is this, that even the most experienced photographer may occasionally fail. The reason of this is that the processes coming after development very much modify the apparent density of the negative, and not only that, but in every different make of plate the apparent density is modified to a different degree. We must make the negative appear far denser than it is eventually to be. It is only by experience that knowledge approaching to exactness can be gained on this point. When I come to the chapters on printing, I shall explain more fully the characteristics of an over-dense, and a "thin" or under-dense negative. Just now I shall merely indicate the manner in which it is usual to

judge of the density. The red light must be turned pretty high. The plate must be lifted from the developer, and held, with the film side towards the observer, for a few seconds only, close to the light, and between the light and the photographer. He must rapidly judge whether or not the density is correct. It may be roughly said that, as a rule, the densest parts should appear almost, if not quite, opaque. If they do not, the plate must be returned to the developer.

I shall suppose the right density to have been gained. The time taken with the developer I have given will probably be from three to six minutes. The developer is now poured back into the measure. If used within an hour or so, or any time before the colour has turned a dark brown, one or two more plates may be developed with it. A plate, after development, is rinsed under the tap, being either held in the hand or left in the flat dish. After this as much red light may be admitted as is wished. Then the plate is laid for five minutes in the alum solution, to harden the gelatine film. It is again thoroughly rinsed, and is placed in the fixing solution. It will have been observed that up to this time the plate, looked at from the back, still appeared white. This is because the sensitive salt of silver which was not acted upon by light still remained in the film. On placing the plate in the hyposulphite, this whiteness will gradually vanish. When there is no further appearance of it from the back, white light may be freely admitted. The plate must still be left a few minutes in the fixing solution, however, after which it must be most thoroughly washed. It should remain at least half an hour either under running water, or in frequent changes of clean water. After that it is reared upon edge to dry, when the negative is complete. Heat must on no account be used in drying.

CHAPTER VI.

LENSES: OLD AND NEW.

Of all the apparatus the photographer uses, there is none of so great importance as the lens. With a bad camera shift can be made, and excellent work turned out, the only drawback being more labour and inconvenience for the operator; but with a bad or unsuitable lens nothing good can be done. This being the case, it is desirable to give a short description of the various lenses in use, saying for what kind of work each is best suited. Before doing so, however, I will give a few general facts with regard to lenses, and especially I shall lay stress on the manner in which it is possible to compare the rapidity of different lenses. It will be necessary to define a few technical terms continually applied to lenses.

The *focus*—or, more correctly, *focal length**—is the distance between that point (generally in the lens) where lines joining points in a distant object and in the image cross each other, and that point on the axis of the lens where parallel rays of light are brought to converge to a point by the lens.

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* When the focus or focal length is talked of here, "equivalent focus" always is meant. The term "back focus," often used by opticians, means simply the distance between the back glass of a lens and the ground glass. This distance it is not important to know, except in connection with the adjustment of the lens or the camera.

This is possibly a meaningless definition to the beginner, in which case he need merely bear in mind that for the purpose of determining exposure, sufficient accuracy is gained in the case of a single landscape lens by taking the focus as the distance between the lens and the ground glass; and in the case of a double combination lens of modern construction, either view or portrait, by taking the distance between the diaphragm and the ground glass, a distant object in each case being focussed.

In the case of the orthoscopic, and various other forms of lenses, including some of the NEW, this manner of determination is not accurate enough, even for the calculation of exposures; the following method of determination will, however, give results of sufficient accuracy. In front of the camera is placed a foot-rule, or other convenient object. The distance between the foot-rule and the lens, and that between the lens and the ground glass, are so adjusted that the image on the ground glass is of the same size as the object. The distance from the foot-rule to the ground glass is now measured. This, divided by 4, is the equivalent focal length.

Example.—When we draw out a camera till the image on the ground glass is equal in size to the object, we find that the distance from the object to the ground glass is 32 inches. One-quarter of this, or 8 inches, is the equivalent focus.

The following method may be adopted when the camera will not rack out to twice the focal length of the lens. It is capable of giving very precise* results, but requires a slight knowledge of algebra.

d = distance from object to ground glass when a near object is focussed.

o = length of object focussed (preferably a measuring rod).

i = length of the image of this rod on the ground glass.

* Not mathematically accurate, but well within the limits required by the photographer.

$F =$ lesser conjugate focus—that is to say, the distance between the optical centre of the lens and the ground glass when a *near* object is focussed.

$f =$ equivalent focus.

$$F = \frac{i \times d}{o + i}$$

$$f = \frac{F\,(d - F)}{d}$$

Example.—A 5-foot rod is focussed. The length of the image on the ground glass is found to be 6 inches. The distance between the rod and the ground glass is found to be 10 feet 1 inch.

$$F = \frac{6 \text{ ins.} \times 10 \text{ ft. } 1 \text{ in.}}{5 \text{ ft. } 0 \text{ in.} + 6 \text{ ins.}} = \frac{6 \times 121}{60 + 6} = \frac{726}{66} = 11$$

$$f = \frac{11\,(121 - 11)}{121} = \frac{1210}{121} = 10$$

Equivalent focus, therefore, is 10 inches.*

The aperture of a lens is the diameter of the smallest combination forming it, or of whatever stop smaller than this may be in the lens.

By *full aperture* of a lens is meant, in the case of a single achromatic lens, the diameter of the largest stop with which the lens will give good definition in one plane; that is to say, the diameter of the fixed stop with which the optician fits the lens. In the case of a double combination lens, it is the diameter of the front combination if the two be of equal diameter; of the smaller combination if the two be of unequal diameters; or of the fixed stop if such be smaller than either of the combinations. In the case of a triplet lens, the "full aperture" is

* There is a very slight residual error even with this calculation, but it is of no consequence, except in very accurate cartological and other such work.

the diameter of the smallest combination, or of the fixed stop if this be smaller than any of the combinations.*

By *depth of focus* is meant the power in the lens to represent objects both near and far from the lens apparently equally sharp. Actually equally sharp they cannot be, except inasmuch as every one point at a distance farther from the plane actually focussed for has a corresponding point nearer than that plane which is equally sharp. I retain "depth of focus" as being the commonly used term, although "depth of definition" has been suggested—I think by the late Mr. J. Traill Taylor—and is a better term. The larger the aperture or the longer the focus of the lens, the less the depth of focus. With every lens is supplied a set of stops or diaphragms. These are simply thin metal plates with holes of larger and smaller sizes in them,

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* The definition of "full aperture" is not strictly correct as described for double and triple combination lenses of the older forms, but it is accurate enough for all practical purposes with them; it is not, however, with some of the dis-symmetrical forms of the NEW LENSES. If it is found with one of these—or, indeed, with any lens—that the diameter of the fixed or practically largest diameter of stop is quite appreciably larger than the front combination, the following method may be followed:—A small piece of any kind of printing-out sensitised paper is fixed in the position of the diaphragm, the sensitised side towards the front combination, and the lens is placed directly facing full sunshine, till a darkened circle is printed on it, which will not need half a minute. If the diameter of this circle is not larger than the fixed, then the diameter of the front combination is the full aperture. If the diameter of the circle is larger than that of the fixed stop, then the following very simple calculation is made:—

c = diameter of circle.
d = diameter fixed.
d_1 = diameter of front combination.
a = full aperture.

Then—

$$a = \frac{d \times d_1}{c}$$

made to slip in front of or between the combinations of a lens. The more depth of focus is needed, the smaller the stop that must be used, and consequently the slower the lens will be.

By *width of angle* is meant the amount of picture that can be included without complete falling-off of definition, or of light, towards the edges of the plate. Let us suppose that a camera with a certain lens is placed opposite a row of houses. It is necessary, to illustrate this point, to suppose the camera to have a very large ground glass, larger than there is any chance of the lens covering. It may be found that only the central part of the ground glass shows a sharp image, all beyond being "fuzzy," or even quite dark. Possibly two houses are represented with fair sharpness. Now let us suppose another lens of different make, but of the same focal length, to be substituted for the first. The two houses which gave a sharp image on the ground glass before will give a precisely similar image now, but possibly a house on each side of these will also be well-defined. In this case the latter lens is comparatively a *wide-angle* one. It must be understood that narrow and wide-angle lenses give images of the exact same scale if the focal lengths be the same; the latter form of lens takes in a wide angle only on a larger plate, or on the same sized plate only by using a lens of shorter focal length.

Distortion is a fault met with in some photographic lenses. It causes straight lines near the margin of the object to be represented by curved lines in the image. Of lenses now not quite antiquated the only ones that give distortion are the older single achromatic and the NEW single anastigmatic. In the latter the distortion is reduced to a minimum, and even with the single achromatic distortion will not be appreciable if the vice of attempting anything other than a narrow angle be scrupulously avoided.

Flatness of field is, roughly speaking, the quality in a lens of

having the definition at the edge of the plate nearly as good as that at the centre.

It is never actually as good on account of the presence in all lenses of a certain amount of *roundness of field* and *astigmatism*, either or both, generally both, for of a large number of lenses that I have accurately tested for field and astigmatism there was only one that showed perfect flatness, one (a NEW LENS) which showed but very little of roundness of field, and that in a direction opposite to the usual; there was only one in which astigmatism could not be detected.

Roundness of Field.—This is a defect due to the fact that the pencils of light passing through a lens do not come to a focus on a plane, such as the ground glass or a dry plate, but more nearly on an imaginary curved surface more or less approaching a part of the surface of a sphere. The oblique pencils nearly always come to a focus in *front* of a ground glass adjusted for the axial pencil. This is very easily proved by taking in a fairly wide angle with any of the old lenses, using its full aperture. If the centre of the image is made sharp, it will be seen that the extreme marginal image is woefully out of focus, and that it is necessary to bring the lens nearer to the ground glass to get even fair sharpness.

The NEW LENSES show much less roundness than the old, and may, in fact, be described as practically *flat of field* for moderate angles, even using full aperture.

Astigmatism (meaning "not a point") is a word used by oculists and opticians in slightly different senses. The photographic sense is here explained.

Let any very bright object so small as to approach a point—about the best of all is the reflection of the sun as seen in a "silver" Christmas-tree ball—be focussed first in the middle of the ground glass, using any of the old forms of rapid lenses, with a large aperture. A minute, sharply-defined spot, which may be

called a point, will result. Let the camera now be rotated on the stand till the image of the bright spot falls on the margin of the plate. No adjustment of focus will now produce anything like a point. At two distances of camera and ground glass and lens there will be more or less sharp images, but they will be in the form of *short* bright *lines*, in one case radial—that is to say, pointing towards the centre of the plate—in the other case tangential—that is to say, pointing at right angles to this direction—whilst at all intermediate distances there are produced undefined blurs of various sizes and shapes.

In the old lenses astigmatism could be reduced only to a very slight extent, except at the expense of increased roundness of field, and the struggle of the opticians was to reduce one of these two defects without increasing the other, or to reduce both without introducing some other. In the NEW LENSES astigmatism is very greatly decreased, while the field is at the same time much flattened.

Spherical Aberration is due to improper form or material of lenses, or inaccurate centering. Even the middle of the image cannot be made sharp with full aperture or fixed stop. This defect is scarcely ever met with in modern lenses by respectable makers; but some makers purposely leave the fixed stops of single lenses so large that even central sharpness cannot be got, and others open out the apertures of old lenses for the same purpose. The object is to get a certain softness which is much admired by some, especially in the case of large-sized heads. The rapidity is, of course, increased.

Chromatic Aberration.—With this fault the strongest visible light rays (with which we focus) and the strongest chemical rays (with which we photograph) come to a focus at different distances from the lens, so that, even if we get a sharp image on the ground glass, the image on a plate replacing it is not sharp. The fault is scarcely ever present to an appreciable extent in at all modern lenses by respectable makers.

Distorted Perspective.—This effect is produced by including too wide an angle. Such must sometimes be done if some object *has* to be photographed and we cannot get far enough away from it. The result is an exaggerated appearance of all near objects, the dwarfing of all distant ones, and the actual distortion—to all intents and purposes—of the very forms of solid objects. A false impression is given, and if wide-angles are included in photographs for illustrating houses and grounds for sale, or any of many other objects, the impression may be *fraudulently* false.

On the other hand, by pushing the capacity of a very wide angle to the extreme, most ludicrous results of figures, &c., may be had, which will give great amusement to many, especially if shown at lantern exhibitions for young folks, or the like.

The *rapidity* does not need to be defined, but I propose to explain the factors regulating it. Every lens is of different rapidity from others of another form, and each lens has a number of diaphragms varying its rapidity, so that at first sight it might appear a difficult task to put a value on the speed of a lens using any particular diaphragm. The law governing the rapidity of lenses is, however, so very simple that its application is most easy, and I would try to impress upon the beginner that he should thoroughly master it at the beginning of his practice. If he do so he will find the estimation of the necessary exposure a comparatively simple matter. In changing one stop for another, or one lens for another, he will have nothing to guess except the intensity of the light. I give, further on, a set of tables that almost entirely do away with the necessity for even this small amount of calculation.

The method of comparing lenses—one which applies to all lenses—is as follows. State the ratios between the apertures of the lenses and the focal lengths of the lenses as fractions—

the aperture as the numerator, the focal length as the denominator. Square the fractions thus obtained, and the resulting figures will give the ratios of the rapidity. It is usual to state the fractions thus: *f*/4, *f*/12, *f*/40. These fractions refer to lenses the first of which has an aperture one-fourth of the focal length, the second one-twelfth, and the third one-fortieth. We shall take a practical example. We are using a portrait lens 10 in. focus, and aperture 2½ ins.; that is, the focal length is four times the aperture, or we may say the lens is working at *f*/4. The focal length, be it remembered, is taken as the distance between the diaphragm and the ground glass. We now substitute a single lens of 12-inch focus with a stop ¾-inch in diameter. The aperture is now $\frac{1}{16}$ of the focal length. The lens is working at *f*/16. Square these two fractions, thus:—

$$(\tfrac{1}{4})^2 = \tfrac{1}{16}, \quad (\tfrac{1}{16})^2 = \tfrac{1}{256}.$$

The rapidity of the lenses is as $\frac{1}{16}$ to $\frac{1}{256}$. The exposure needed will therefore be as 16 to 256, or as 1 to 16. Thus, if we had been giving two seconds with the portrait lens, we should have to give, on the same subject, thirty-two seconds with the single lens. If the beginner will exercise himself in this rule for a little time, he will find that he soon gains great facility in applying it, and that it gives him a very great power in estimating the necessary length of exposure. With the same lens and different stops, the rapidity varies as the square of the diameter of the stop, or as the area of the stop.

I shall now rapidly describe different kinds of lenses most in use, both old and NEW, giving the purposes for which each particular form is best adapted; but before doing so I must attempt a broad classification of the two.

THE OLD AND THE NEW LENSES.

I have said so much about the superiority of the new lenses that I fear the beginner may be frightened into the idea that he

can never hope to turn out the highest class of work unless he provide himself with one of the comparatively very expensive NEW lenses. If his object were any of some kinds of scientific or technical work, he would be right, for the advances in the qualities of optical glass, which made the NEW LENSES possible, may be said to have revolutionised both scientific photography and microscopy. If, on the other hand, his object is to *make pictures*, there is no necessity for—and, indeed, very little advantage, except for hand-camera work in—the NEW LENSES.

I will guarantee that, if he have taste and patience enough to make good pictures at all, a photographer working a stand camera will make ninety-nine good pictures with a really good *Rapid Rectilinear* or *Rapid Symmetrical*, as he will perhaps a hundred with the option of using any one of the NEW LENSES of the same focal length. *Occasionally* a subject may be met with which becomes possible with a NEW LENS, whilst it would be impossible with the *old;* or easy with the NEW, difficult with the *old*. On the other hand, the very faults of the *old lenses* are advantages in the eyes of some. They look on the falling-off of sharpness of the image towards the edges, so noticeable when any of the old lenses are used with a large aperture, as a "softening" of the picture which adds to the artistic effect, and I think they are right—at any rate, for some subjects, and within limits. It is nearly always an advantage rather than the reverse in the case of pictures to be vignetted, concerning which another chapter may be referred to.

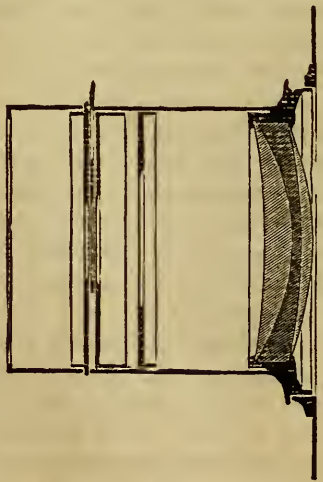
In the case of the *hand-camera*, especially when the negatives are to be used for enlargement, the special qualities of the NEW LENSES are much more manifest than in that of the *stand camera*. This is because, with a great part of hand-camera work, the cry is for light, more light to pass through the lens and fall on the plate. In other words, we want the largest aperture compatible with fair marginal definition; or still again, the

larger such apertures we can use, the greater becomes the possible field. With the old forms of rapid lens, the largest aperture that can be used is generally about $f/8$, or $f/11$, if anything like good marginal definition is demanded. With the NEW LENSES, apertures of $f/6{\cdot}3$, or even $f/3{\cdot}6$, are available. This latter aperture makes instantaneous work (say $\frac{1}{10}$ second exposure) quite possible in ordinary rooms.

Fortunately, hand-camera work is nearly all done with lenses of small size, and even NEW LENSES are not of ruinous cost. In enlarging the NEW LENSES show up to great advantage.

The advantages of the NEW LENSES for photo-mechanical work and for animated photography cannot be over-estimated, but these are beyond the limits of my subject, and cannot be treated here.

THE SINGLE ACHROMATIC LENS.



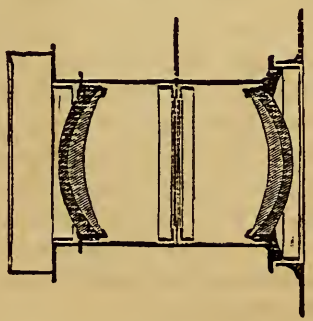
This is the simplest form of lens, and is in many respects excellent. It is fairly rapid, especially in some of the new

"long focus" forms, includes all the angle that is desirable for general work, and gives wonderful definition, whilst it is the least expensive form of lens made. Its only drawback is that it gives slight distortion. If, for example, it is attempted to photograph a building with it, nearly the whole plate being covered, the boundary lines will appear slightly curved, and the building will seem somewhat barrel-shaped. This distortion is, however, barely perceptible if the focal length of the lens be at least $1\frac{1}{3}$ times the length of the plate, and, if the beginner cannot well afford to buy the next lens to be mentioned, he will find that he can do excellent work with the "single achromatic." Single lenses vary somewhat in construction. That shown is not the cheapest, which has only two glasses, and is very nearly as good.

The Universal.

This is one of several names given to a lens of about twice the rapidity of the rapid rectilinear, but of the same construction. It makes an excellent portrait lens, and can be used full aperture for a great deal of that kind of work. It can also be used for landscape work, but with such must nearly always be stopped, at any rate, to *f*/8.

The Rapid Rectilinear or Rapid Symmetrical

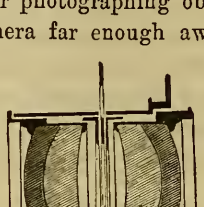


is one of the most useful of lenses. It is very rapid, and one

should be purchased when the photographer has so far advanced as to wish to attempt instantaneous effects. It gives no distortions, and includes about the same angle as the single lens.

The Symmetrical or Wide-Angle Rectilinear

is a somewhat slow lens, but takes in a wonderfully wide angle, so that it is useful for photographing objects when it is impossible to get the camera far enough away from them to use

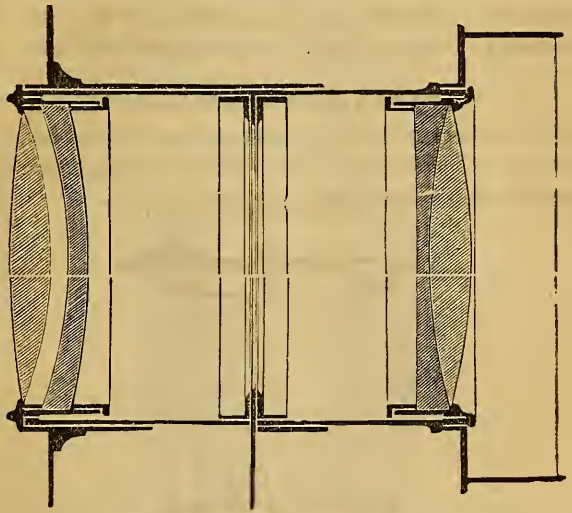


the rapid rectilinear. It is quite free from distortion. The cut shows one of several forms, all of which are a little different from each other.

The Portrait Lens

is intended for portraiture pure and simple. The utmost ingenuity has been spent in the case of this lens to get the greatest possible rapidity, but many other good qualities have been sacrificed. Thus the field is round, the marginal definition bad, and there is very little depth of focus. For its own particular purpose it is, however, admirably adapted. With the very rapid plates that can now be had, it is quite possible to take portraits even indoors with the rapid rectilinear or the single lens, and we do not advise the beginner to purchase a portrait lens. This is particularly true since the introduction of the Universal lenses described above.

There are numerous photographic lenses sold under names different from any of the above, but all of the old type will be found to be very similar in action, if not in construction, to one or other of the kinds illustrated. As I am entirely avoiding in these pages all historical reference, I do not describe these lenses, which



have now almost gone out of use, and are not manufactured; but I may mention the "orthoscopic," "orthographic," "wide-angle doublet," "instantaneous doublet," and "triplet" lenses as instruments to be occasionally met with, and which, if not quite so good as our more modern instruments, nevertheless possess excellent qualities.

THE NEW LENSES.

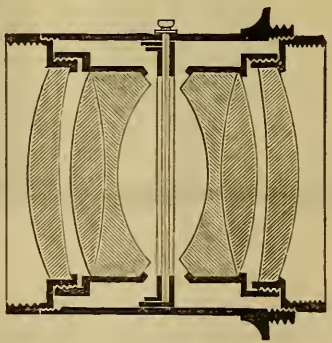
Extra-Rapid Lenses.

These lenses are primarily intended to take the place of the old form of portrait lens just illustrated, as they are as rapid, or

nearly so, but, as they give perfect marginal definition through a fairly wide angle, they may be used for hand-camera and other kinds of instantaneous work. They display no improvement in *depth* of *focus*, however, over the old portrait lens, except just inasmuch as they are generally a little slower. *Depth* of focus is determined entirely by *focal length* and *aperture*, and is independent of form, material, or workmanship of lens.

The Planar Anastigmatic.

This is an invention of a German optician of great fame. The lens works at apertures of from *f*/3·6 to *f*/6 according to size, the smaller lenses being, as a rule, the rapidest.



The nearness of the combinations make the illumination of the field more uniform than that of the corresponding old portrait lens; but this may be said of all the new lenses when compared with their old prototypes, except in the cases of the *single achromatic* and the *single anastigmatic*, and of wide-angle lenses.

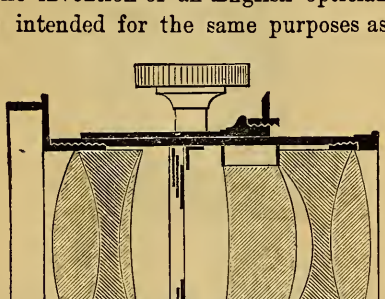
It has two fewer reflecting surfaces than the last lens illustrated, which fact must be looked on as an advantage, for every reflecting surface is also a diffusing surface, throwing diffused

light into the camera, and thus dulling the image. Hence the superiority of the "single lens" when it may be used.

I believe I was the first to suggest the name "stigmatic" as better than "anastigmatic," which involves a double negative.

The Stigmatic.

This lens, the invention of an English optician of very high reputation, is intended for the same purposes as the last, and



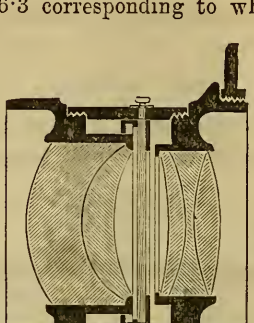
has the same excellent qualities. It has a full aperture of *f*/4 in its rapidest form.

Very Rapid Lenses.

I thus class lenses that are about twice as rapid as the old *rapid symmetricals* or *rectilinear* lenses. Unless the extreme rapidity of the *extra rapids* is really needed, the *very rapid* lenses are better for landscape and hand-camera work. They make good portrait lenses, but should be used for such work only of long focus (relative to the size of the plate), in which the wonderful covering power for which we have to pay so much is not utilised.

The F : 6·3 Anastigmat.

This lens is the invention of the German optician already mentioned, the F : 6·3 corresponding to what we would write



$f/6·3$. It has proved very useful in my hands, especially for enlarging. This means no slur on its usefulness for other kinds of work; it is simply that I have used it more in enlarging than for any other purpose. It is a lens of high class for nearly all kinds of photography, including hand-camera work.

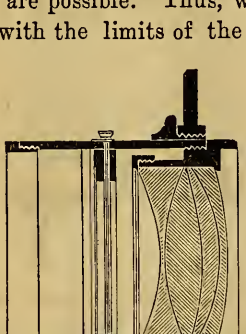
Convertible Single Anastigmatic Lenses.

This, a German invention, is an improvement on the *single achromatic*. It gives much better marginal definition, with increased rapidity. It gives perfect definition at $f/12·5$; and this makes it applicable to many kinds of instantaneous work, though not quite rapid enough for all-round hand-camera work. Distortion is reduced to a minimum.

The lens, used *as a single lens*, is illustrated here, but its peculiar feature is its adaptability to forming one-half of a very rapid rectilinear anastigmatic lens.

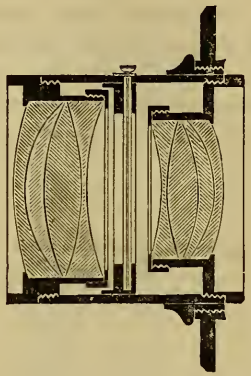
This brings us to a subject not even mentioned up to the present time, namely—

The advantage of having several lenses of different focal lengths at disposal. The beginner has been assumed to be a "one-lens man" (woman or child), but if he understands the relation between focal length and size of image, he will readily conceive that, though one particular lens may be that most generally used, more than one is necessary to get satisfactory results in all cases where such are possible. Thus, with a fixed (or best) point of view, and with the limits of the picture fixed to the



limits of the plate, there is hypothetically only one certain focal length that will serve. In practice there is a good deal of latitude, especially as the print does not need to be as large as the negative; but it is of very great advantage to have several lenses of different focal lengths available. This can, of course, be arranged by having several entirely different lenses, but the *convertible single anastigmatic* makes it possible to have quite a battery of lenses in a very portable and convenient form. This is because every *single* convertible

anastigmatic lens may be used either alone as a long-focus lens, or as one-half of a rapid shorter focus doublet (double combination) lens. Not only this, but two single convertible lenses of different focal lengths can be used to screw into the two ends of a doublet, and produce a rapid anastigmatic doublet, as shown



here. This means three different focal lengths, those of each "single" alone, and that of the two combined. With *three* "singles" we have no less than six available focal lengths, by using the lenses separately, and combining them in different ways by the aid of lens tubes or mounts provided by the optician. Thus, referring to a catalogue, we find recommended for a half-plate "set"—

1 single anastigmatic of 9 ins. focus.
1 ,, ,, 11½ ,,
1 ,, ,, 14 ,,

Resulting in the following possible focal lengths and full apertures:—

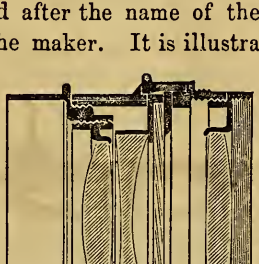
Focal Lengths.	Full Apertures.
14 inches	*f*/12·5
11½ ,, ...	*f*/12·5

Focal Lengths.				Full Apertures.
9 inches	...	...	...	$f/12{\cdot}5$
7 ,,	...	...	...	$f/7$
$6\frac{1}{4}$,,	...	...	...	$f/8$
$5\frac{3}{4}$* ,,	...	...	...	$f/7$

From four lenses of this *single* anastigmatic type, nine different focal lengths can be had, &c.

The Cooke Lens.

This lens is called after the name of the inventor, which is given as he is not the maker. It is illustrated below.



The Cooke lens differs from all the other NEW LENSES, inasmuch as the inventor has been able to work out the problem of nearly eliminating astigmatism and of flattening the field without the use of the new Abbe-Schott optical glass, the wonderful and various powers of which have alone made all the other NEW LENSES possible. The old optical *flint* and *crown* glass only are used, so that the price is comparatively moderate. The working aperture is $f/6{\cdot}5$. I believe that a Cooke lens is also made to work at $f/4$, which would, of course, come under the heading of "extra rapid," but I have no drawing of it by me.

* A wide-angle lens.

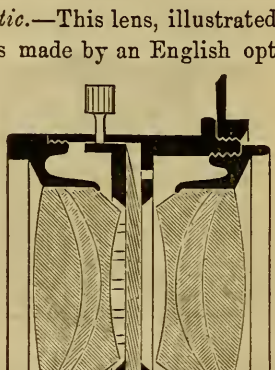
I have not tested or used any of the Cooke lenses myself, but I have had very favourable accounts of them from several different friends, all quite disinterested.

I would wish it understood that, so far as concerns all other lenses described here, or even mentioned, I speak from actual experience.

Other Forms of the New Lenses.

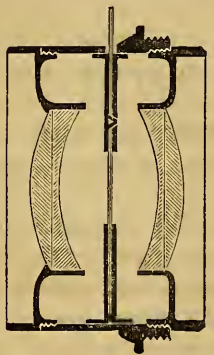
Rapid Anastigmatic Lenses.—These are of about the same rapidity as *rapid rectilinear* lenses, and give much better marginal definition.

The Platystigmatic.—This lens, illustrated below, and called the *Platystigmat*, is made by an English optician, nearly all of



whose different forms of lenses I have used during the past fifteen years, and all of which, including the Platystigmat, have proved to be of the highest quality, though comparatively moderate in price. The aperture is *f*/8, not more than that of the old "rapid" lenses; but it is a great improvement on them in the matter of marginal definition. It is a good lens for hand-camera work where the greatest rapidity is not considered essential.

Wide-Angle Anastigmatic Lenses.—These perform the same functions as the older *wide-angle symmetricals, wide-angle rectilinears,* &c. They give better marginal definition with the same aperture, or the same with a larger aperture. They are of various forms, of which one, called the "Concentric," is here



illustrated. It is a slow lens working sharp at an aperture of only *f*/20 or less, but has the unique property of being without perceptible astigmatism, even when used to cover a large plate.

Tele-Photographic Lenses.—These give very large images with a moderate extension of camera, and are useful for photographing distant objects, though they are slow in action and a little difficult to manipulate, so that they scarcely come within the class of instruments that the beginner needs to take into consideration.

"Made in Germany."

The two famous German opticians who have been the pioneers in anastigmatic lenses have licensed an optician of high standing in each of the great countries of the world to manufacture lenses in accordance with their patents, so that he who wishes to patronise native enterprise may do so; but this is not to be taken as any slur on the German products, these being, apart from design, of the very highest type in the matters of material, workmanship, and finish.

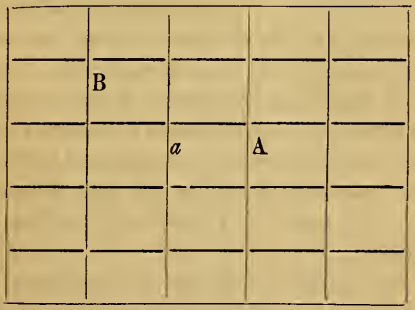
CHAPTER VII.

THE MANAGEMENT OF THE CAMERA IN THE FIELD—THE SWING-BACK, RISING FRONT, ETC.

If the photographer has diligently perused the preceding chapters, and has gone through the various manipulations described in them, he will now be ready to sally forth into the field, and, selecting the beauty spots of nature, to transcribe them by the aid of his camera and lens. He may, in fact, make pictures.

I have declared my intention of not entering into the question of art in connection with photography, but have referred the reader to more advanced works for guidance in this direction. Yet a few general remarks on the subject, made with much diffidence, may not be out of place, especially in indicating those points wherein the requirements for a photographic picture differ from those for a painting. The chief of these arises, of course, from the absence of colour in the former. We cannot have transcribed by the camera the broad contrasts which are frequently brought out by colour alone. We must trust entirely to form and to light and shade. Very frequently a scene will make a most perfect picture on the camera ground glass, when the experienced photographer knows it will make nothing in the print. Alas! the colour which makes the picture cannot be reproduced.

This makes it all the more necessary in the case of the camera to have the outline and the shades of light harmonious and well balanced, for on them alone must the picture depend. The picture must not be all on one side, nor yet should it be in each half similar. The most striking object should not, as a rule, be in the centre of the picture, but somewhat to one side or the other, there being an object of secondary interest on the opposite side of the picture—but not symmetrically opposite—to balance it. The late Mr. Norman Macbeth, a painter of much talent, has read various papers before photographic societies, propounding the view that if the space occupied by the landscape be divided horizontally and vertically into five or seven equal portions, the primary and secondary points of interest should fall on the intersections of these lines, but not on bi-laterally symmetrical intersections. To illustrate this, I give a set of



intersecting lines as described. If, now, the primary point of interest be at A, the secondary point of interest must not be at *a*, but at B.

The horizon line should, as a rule, be about one-third or two-fifths of the height of the picture, either from the top or the bottom. There must not be too large patches of either very dark shade or of light without some small portions of the

contrary shade to relieve them. There must not, as a rule, be running in any direction through the picture long and uninterrupted straight lines.

For the rest, there is generally wanting to a perfect landscape picture—be it painting, drawing, or photograph—a foreground, a middle distance, a distance, and a *principal object*. This latter is generally situated in the middle distance, or towards or in the foreground. It is in the distance that photography oftenest fails. What to the eye appears a definite distant landscape —the distance but lending enchantment and softness—comes out in a photograph so dim and faint that it would seem to be almost hidden by a thick mist. The slight haze which, in England at least, generally appears between us and the distance, is exaggerated so as almost to obscure those things which are quite clear to the eye. A certain amount of haze covering the most distant objects in a photographic landscape is, indeed, necessary to give the idea of distance at all, and on the way in which this is managed will depend, more than on anything else, the success or failure of the picture from an artistic point of view. The difficulty is to be found in the fact that the haze actually seen is always greatly exaggerated in the camera. It is, therefore, necessary to allow for the difference between what is seen in nature, and what will be the result in the finished picture.

Perhaps the greatest difficulty in landscape photography, however, is that the sky is not, as a rule, rendered at all. An exposure which will suffice to bring out all the detail in a landscape, is such that the sky will be so over-exposed as to show no trace of cloud, but only an even expanse of white. It is necessary, to get the sky, to make a special exposure, perhaps about one-tenth to one-fourth of that needed for the landscape, and to resort to a "double-printing" process, to be described hereafter, or to use some "dodge" whereby the sky gets a

much shorter exposure than the landscape, especially the foreground.

I shall briefly describe the subjects best suited for the camera. Landscapes having, apart from colour, broad and well-marked contrasts of light and shade, and decided outline of form, are specially suitable. Trees of all kinds are well rendered, both with and without their leaves; in the former case the difficulty is to get them motionless. A quite windless day is necessary, unless the light be so good that the exposure need be only a fraction of a second. Architectural subjects of all kinds are most perfectly reproduced by the camera.

The most charming effects of any are, perhaps, produced in a scene in which there is water—a quiet pool with reflections of trees, for instance; shipping in motion, &c., will be treated of in the chapter on instantaneous work.*

Let us suppose some locality has been determined on where

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* The above is a brief epitome of a set of general principles that have never been taken as absolute rules, but that have been believed to give useful assistance to many photographers who have tried to produce really artistic pictures. Since it was written, there has arisen a school of photographers calling themselves "naturalists," who discard all such rules even as suggestions. Their views are represented—or rather, perhaps, it would be more correct to say they arose from—a book entitled "Naturalistic Photography," written by Dr. P. H. Emerson. [Dr. Emerson having recanted all that he taught in this book, it is difficult to know what to say, but that the discussion that arose from it, and the attention that it drew to the artistic side of photography, has done much good.] This book should certainly be read by all photographers. It displays much originality, and, in spite of what are considered by many to be grave errors, the student cannot but learn much from it—at least, from those parts that treat solely on the art part of the question—and they would certainly learn more if the author had been more tolerant, and less dogmatic. Those who wish to gather the views of the older school, which Emerson strongly opposed, should read the works of H. P. Robinson.

the photographer is sure to find subjects such as those which have just been mentioned. I shall describe, as accurately as I can, how he should proceed. Before he leaves home he has to fill his slides. After he has done so, he should draw out each shutter of each slide, and gently dust the surface of the plate with a piece of soft cotton-wool, or a camel's hair brush. Let us suppose he has three double slides; they are carried in a case which should be made to hold them and the camera. Besides these, he must take his lens, his tripod—and let him be most careful not to leave the screw* behind him—his focussing cloth, and possibly a "focussing magnifier." This is a small eye-piece to magnify the ground-glass image, and assist him in focussing with precision. It is useful greatly because it increases the light. When a small stop is used, the ground-glass image is often so dull that it can barely be seen.

Arrived at the scene of action, the photographer must select his point of view most carefully. Let him be in no hurry; often a picture will be made or spoiled by changing by a few yards the position of the camera. When he has quite made up his mind, let him unfold his camera, erect it, and place it before the scene to be depicted.

A few words on the management of the tripod stand. With the beginner this is apt to prove most wonderful and fearful in its movements. The effect of moving any one leg appears to be the exact opposite of what might have been reasonably expected. After long struggles the whole apparatus assumes an appearance of hopeless intoxication, and finally collapses, very possibly

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* Cameras are now made with "turn-tables"—that is to say that, instead of the usual triangle of the legs, there is a revolving disc which forms part of the camera, and to which the legs may be directly attached. There is thus no loose screw to forget, and in every way the arrangement is a very convenient one.

pinching severely the tyro's fingers between the tail-board and one leg; after which frequently follows language not to be repeated here. Let the stand be, however, once for all, placed on the ground with its three legs about equally far, and a good distance, apart, and with one of them pointing in the direction of the scene to be photographed, and all trouble will cease. There will be room for the photographer to focus comfortably standing between the two back legs. To tip the camera up, all that is necessary is to draw the forward leg towards him; to tip it down, he need only push it from him. He may still further tip the camera up by spreading the back legs apart; and down by bringing them together. He may turn it slightly to one side or the other by swivelling it on the screw, without moving the stand.

When the camera is fixed, and the view is focussed, it will probably be found that there is too much foreground and too little sky. Now, one of two things may be done. The camera may be "tipped" up. In this case, if there be any parallel vertical lines in the picture, they will be made to converge towards the top, and it will be necessary to bring the swing-back into play, as will be shortly described. If there be no vertical parallel lines, the camera may be tipped a little without appreciably modifying the result, or the camera front and lens may be raised in the manner to be described hereafter. Most cameras are made so that either a vertical or horizontal picture can be taken, and judgment must be used to determine in which position it shall be. All the points above indicated having been considered, and the picture being all on the ground glass—proceedings so far having been conducted with open aperture or a large stop—the final focussing must be done. The principal object—generally, as before remarked, in the middle distance—must be made absolutely sharp. Then stops smaller and smaller must be tried, till the distance is *just* sharp;

or better, in most cases, just *not quite* sharp.* Some lenses have a little residual spherical aberration left to give a soft effect in using the full aperture. With these the focussing should not be done with full aperture, unless such is actually to be used. It is a good thing to make it a rule, with all lenses but those of the wide-angle type, to focus with the stop to be used if it be one of the two or three largest, with a stop about half the diameter of full aperture if a small stop is finally to be inserted. Many of the so-called "New Photographers," who claim to be very superior persons—or, at least, consider all photographers but themselves very *inferior* persons—hold that a photograph to be really artistic must be *all* more or less out of focus, so, after focussing carefully as described, they extend the camera sufficiently to make even the foreground and the principal object somewhat—sometimes very—fuzzy, or, as they call it, "soft."

Now all is ready for exposure. Let plate No. 1 be exposed first, and on no account let any plate be exposed other than in its order, else the photographer will be likely to expose two views on the same plate—a much more irritating thing he cannot do. In exposing, procedure is exactly as described in a former chapter. There is given further on a set of Tables, from which may be learned, as accurately as it is possible to learn from anything but judgment gained from experience, the exposure which it is necessary to give for different subjects.

It may be said that, for a landscape, the most pleasing lighting is usually a side lighting. The lighting looking towards the sun is sometimes very pleasing, but care must be taken not to include the sun itself. This must be either to one side of or

* Many lenses, both of the old and NEW types, are now fitted with "iris diaphragms," which are made up of many thin metal sheaths overlapping each other, and so adjusted that any aperture not greater than the full, and of very nearly a perfect circle, can be got by merely turning a ring outside the mount, or adjusting a peg.

above the picture, or may be kept out of it by the camera being placed in the shadow of a tree or some such object.

The Use of the Rising Front and the Swing-Back.

In the case of most cameras, the board in front of the camera which carries the lens is so constructed that it can be raised to a certain extent, the object in raising it being to get in high objects, and to reduce the amount of foreground seen, which is usually too great when the camera is placed horizontally and the lens is not raised. Many cameras are, as has already been mentioned, fitted with a swing-back, as well as a rising front. The use of this adjustment needs some consideration, as it is often a stumbling-block to beginners, or even sometimes to experienced photographers.

When the subject includes no parallel vertical lines, and when it is seen that it is desirable to take in more of the upper part of it, it is best to tip the camera to a moderate extent. It is not desirable, however, to tip it very much; so if six or eight degrees off the horizontal do not yet let enough of the top of the subject be taken in, the front carrying the lens should be raised till it include all that is wanted. So much for the case of a pure landscape subject, in which there are naturally no quite parallel vertical lines.

In the case, on the other hand, of architectural subjects, it must be taken as an absolute law, that if it is wished to have the vertical lines of the subject rendered as parallel lines in the photograph, the ground-glass of the camera must be kept vertical, whether this object be attained by keeping the camera horizontal and raising the front, or by tipping the camera up and swinging the back, so that the latter returns to the vertical.

It may be said that, so far as it is possible to do so, the desired result should be brought about by raising the lens, as the latter is thereby less "strained," so to speak, than when

the camera is tipped and the back is swung. What is meant by saying that it is less strained, is that its powers are less taxed, so that it is possible to get equally good definition with a large stop, when raising only is resorted to, as with a small one when there is both raising and swinging.

There are two limits to the amount to which the camera front may be raised: the first is a purely mechanical one, and depends on the fact that in all cameras there is only a certain range of rise given; the second depends on the lens. It is evident that, if a lens will just only cover a plate when it is opposite the centre thereof, and if the lens be then raised, the lower part of the plate, representing the upper part of the subject, must simply remain blank. The lens will not cover it at all.

It may be said then that the lens should, for high architectural subjects, be raised till one of the two limits mentioned is reached, after which the camera should be tipped, if it is still necessary. The second limit is much extended in nearly all the NEW LENSES, and, so far as this limit is concerned, it is scarcely ever necessary to swing the back to get it vertical. For this reason, if a NEW LENS is to be used, it is well to select a camera that gives an extra high rise.

It is held by most that vertical lines in architectural subjects should be rendered as absolutely parallel lines on the photograph. The writer is of the opinion that a very slight convergence towards the top is not only allowable, but desirable, especially when a very high and narrow building is to be photographed; because if the lines are left quite parallel, they sometimes appear to *di*verge a little towards the top. The amount should be very slight, however.

It should be borne in mind that to tip the camera does not strain the lens at all if the back be allowed to remain perpendicular to the axis of the lens; that to raise the lens strains it a little; that to tip the camera, and then swing the back, strains

it very much indeed, necessitating the use of an exceedingly small stop, and this with the NEW LENSES as well as with the old.

The use that has just been described of the swing-back is very simple; but there is another use to which it is frequently put, and this fact, that it may be used for two totally different and, as may almost appear, opposite purposes, is the reason why it is often such an incomprehensible arrangement to the beginner.

I shall give a typical case, in which the swing-back is used for the second purpose, when I hope the matter will be quite clear.

We have a pure landscape to photograph, in which we wish to take in, to form the bottom of the picture, a piece of foreground which is not many feet from the camera. The middle of the picture will be filled with a portion of ruined wall at some little distance, whilst behind that is to be seen, at a much greater distance, a rugged crag rising nearly to fill the whole picture. Now we know already, that to have a near object in focus involves racking the camera further out than when we focus for a distant object. To have all the three objects mentioned in focus at the same time would necessitate having the ground-glass at different distances from the lens, the bottom nearer than the centre, and the centre nearer than the top. Now it will be evident, after a moment's consideration, that this condition is fulfilled by swinging the back of the camera *away from the lens*. The only difficulty is to know to what extent we must swing. This is discovered in the following manner by trial and error:—We swing the back to a certain extent, then focus for the centre of the ground-glass. We now notice whether the top part—representing the foreground—can be made sharper by racking the lens either a little farther from or a little nearer to the ground-glass. If we have to rack it a little

farther away, the back has not been swung enough; if we have to rack it nearer, it has been swung too much.

Some cameras are fitted with a "side swing" as well as a "vertical swing." This is to be used precisely as just described, but when one *side* of the subject is nearer the operator than the other.

Hand and Stand Cameras.

All the above applies to those used as stand cameras. Their use as hand-cameras is treated in the next chapter.

CHAPTER VIII.

INSTANTANEOUS PHOTOGRAPHY.

Although "instantaneous" photography was practised to a certain extent before the advent of gelatine dry plates, the difficulties in the way of success were so great that only a few of the most skilled ventured to attempt it. Now all is changed. So easy is it to take what are called instantaneous views, that there is no reason why such should not be included among the work even of the beginner.

The term "instantaneous" is a most indefinite one, and one that might with advantage be disused, could a better be found. Such expressions as "snap-shot" are simply outrages on humanity. It means, of course, a very short space of time, and, with regard to photography is, we may state, commonly used to designate an exposure varying from about half a second to a very much briefer period of time—for the subjects which the landscape or hand-camera photographer is likely to attempt, say to the fiftieth of a second. Much shorter exposures than these are used for special purposes.

As regards the subjects most suitable for instantaneous work with the stand camera, a few words may be said. Of all such, sea scenes come first. Effects of sea and cloud alone often make charming pictures, with the addition of ships in motion even more

so ; river scenes are also well rendered. Much more difficult, and usually much less successful as pictures, are subjects including crowds of people. For such, the exposures must be longer, the lens must be used with larger aperture, or the plates must be more sensitive than for subjects of the nature of those first mentioned. Nevertheless, many wonderful representations of crowds on the sands of the sea-shore, in the streets, and so forth, and even representations of horse races, with their thousands of eager spectators, have been produced with large stand cameras. It is just for these scenes, however, that the *hand-camera* is triumphant, for one reason because it does not attract the attention that is inevitably drawn to the erection of a large camera with stand.

For the shorter exposures mentioned, it is evident that a mechanical instrument is needed. There are many such, but all are classed under the title "instantaneous shutters."

For the first object mentioned, however—namely, sea and sky, without moving shipping, or with only such as is in the distance, or is moving but slowly—an instantaneous shutter is by no means necessary, as a comparatively prolonged exposure may be given.

It is quite possible to give by hand, with a little practice, using the common cap, an exposure as short as a fourth or a fifth of a second. This is quite short enough for the effects which we are just now considering. The cap is rapidly lifted upwards to an inch or two above the lens, then quickly re-adjusted. It is evident that in this manner a somewhat longer exposure will be given to the sea than to the sky, but this is an advantage rather than otherwise.

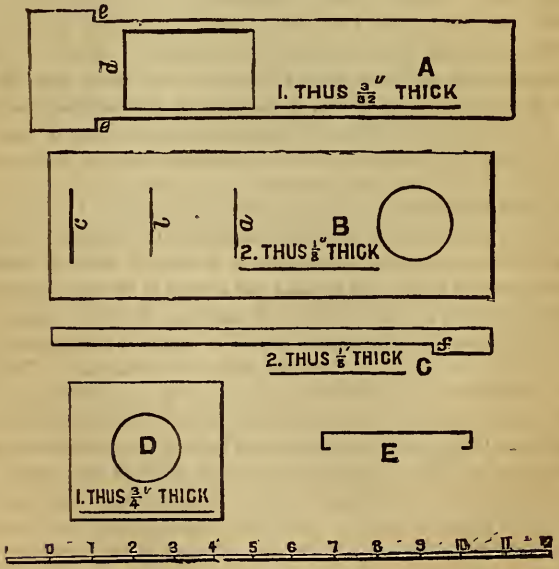
If ships or boats in rapid motion are to be included in the picture, or if men or animals in motion are to be attempted, an instantaneous shutter giving a short exposure is necessary, the aperture of the lens being increased to a corresponding degree.

For most subjects that are capable of forming pictures, exposures of a tenth to a twenty-fifth of a second are sufficiently short. Many elaborate instruments have been invented and are sold with the object of making it possible to vary the exposure, and to adjust it to any desired fraction of a second. This is indeed a desideratum, and several of the instruments mentioned bring it about more or less perfectly. Nevertheless, the beginner need not invest in such,* but may use what—although, probably, theoretically, the least perfect of all shutters—has, as a matter of fact, produced as good results as many others; whilst it has the advantage of extreme simplicity. I mean the drop shutter.

* The improvements made in mechanical shutters since this chapter was written are so great, that I think the photographer of the present day will be best advised to have one from the beginning. Indeed, I retain the following pages and cuts merely because some readers may like to do a little amateur carpentry as well as photography, and because I have turned out as good results with the old drop-shutter as with any of many others that I have used, as good as with an American shutter called the "diaphragm," which is a marvel of ingenuity and a beautiful piece of mechanism, fitted and finished like a mathematical instrument. I cannot take on myself to recommend the shutter of any particular maker, but shall merely say that there are several advantages in a shutter working between the combinations of a lens, and opening and closing at the axis, but that many shutters working in other positions do excellent work in practice. Whatever form of shutter is chosen, it should be observed that it allow the lens to be fully open during the greater part of the exposure. This is, as a rule, attainable only by having the opening, or openings, that admit light long in the direction in which they move. For very short exposures, however, a "focal plane" shutter should be used. In this shutter a narrow slit in a roller blind passes immediately in front of the plate. By this arrangement the "coefficiency of light" is higher than any other. It is true that a certain amount of distortion is introduced, from the fact that all parts of the plate are not exposed at exactly the same time, but the amount of this distortion is generally inappreciable. Shutters with a pneumatic release, in which the exposure is given by pressing a small rubber ball at the end of a flexible rubber tube, are particularly convenient.

This is simply an arrangement whereby a flat piece of wood, vulcanite, or other such material, with an aperture in it, is caused to drop, by its own weight, either in front of or behind the lens, thus for a brief space of time allowing the image to impress itself on the sensitive film. He may purchase a drop shutter at no great expense, or may make one according to the following plan. The sketches given scarcely need explanation as far as construction is concerned (see below).

A is the dropping piece; B, of which there are two, is one of the sides forming a frame through which A drops; C is a distance piece, of which, again, there are two, to keep the two B's



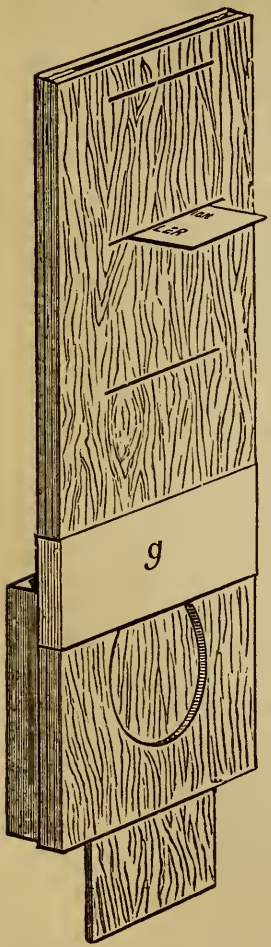
apart; D is a thick piece of wood, in which there is a hole accurately cut to the size of the hood of the lens, so that it may

support the shutter. The arrangement is shown complete in the next cut. Any hard wood forms a suitable material out of which to construct the instrument. The B pieces may, with advantage, be of vulcanite; A is better of wood. If it is made of vulcanite, considerably greater width than is shown must be allowed at each side of the aperture, or the drop is likely to snap the moving piece in two. The frame should be put together with glue and screws.

And now for the action of the arrangement. Of course it is understood that A slides easily, and without friction, between the two pieces B. Indeed, it should drop almost without touching them; *a*, *b*, and *c*, are saw slits through both pieces B. They form a trigger arrangement, and also one whereby it is possible to give a variable exposure. Focussing is done with the piece A entirely removed from the shutter. This is then inserted, a small piece of cardboard, such as a common calling card, being placed in one of the slits, *a*, *b*, or *c*, so that the dropping piece supports itself on *d*. If a comparatively long exposure be needed, the card is put into the slit *a*; if a short one, in the slit *c*; whilst for a medium exposure, *b* is used. The reason of the variation is not far to seek. The velocity of a falling body is, as we all know, uniformly accelerating. It is evident, then, that if the moving part have been allowed to fall for a certain distance, it will fall more rapidly across the aperture than if the exposure began with the falling. The fall is arrested by the projections *e e*, coming into contact with those at *f*. A shutter made to the size given is suitable for a hood $1\frac{1}{4}$ to $1\frac{1}{2}$ inches diameter. It will do well for lens of the rapid symmetrical or rapid rectilinear type, suitable for plates $6\frac{1}{2}$ by $4\frac{3}{4}$, or a little larger. The lengths of the three different exposures given by it are approximately $\frac{1}{8}$, $\frac{1}{16}$, and $\frac{1}{20}$ of a second.

In the accompanying sketch, showing the shutter complete,

g is a piece of blackened tin or ferrotype plate, bent as shown at E, so that it may slide up and down in front of the aperture. By adjusting it, so as to cover a part—say a third—of the upper part of the aperture, the sky is somewhat shaded, without affecting the light the foreground receives, and thus a better result is obtained in certain cases. The lower edge of this shade may, with advantage, be cut into serrations like the teeth of a saw. Such a shade may be attached to any of many different kinds of shutters, and often lends itself to the obtaining of results that cannot be got in any other way.



The feature most worthy of notice in the shutter described is the great length of the aperture of the dropping piece in the direction of its motion. This I consider a most necessary thing. It is impossible here to enter in detail into the reasons for so thinking. I will merely point out that if the moving aperture be only the same length as the diameter of the aperture of the lens, the instrument is, during the whole time of exposure, either opening or closing, and the full force of the light only acts for an infinitely short period. The disadvantage of this does not need to be explained. In the shutter with a long moving aperture, it will be seen that there

is the clear aperture of the lens during the greater part of the exposure. These remarks apply not only to this simple shutter, but to many—indeed, most—shutters.

The long aperture, and the arrangement for varying the exposure, involve a larger instrument than would otherwise be necessary, but I consider this disadvantage more than compensated for in the additional amount of light got.

In instantaneous photography the stand camera is manipulated as for ordinary landscape work up to the time when the exposure is to be made. The instantaneous shutter is then adjusted. The shutters of the dark slide must not be withdrawn till as nearly as possible before the exposure is made. The effect desired is watched for. Nervousness and hurry must be avoided, though it is difficult. It is much more common to expose just too soon, than just too late. When the exact moment has arrived, the card is gently withdrawn, and the plate receives the actinic impression.

Hand-Camera—Instantaneous Work.

To what extent giving even meagre instructions in the use of the hand-camera may come under the head of encouraging vice I do not know, but it is certainly the case that anything I may say here will not appreciably increase or diminish the great present army of hand-cameraists, whilst no book of the present day on photography would be complete without some description of the most popular of photographic instruments.

An outline description of the hand-camera has already been given, and a few words have been said about dark slides, magazines, and plates.

High quality of materials and of workmanship are as essential in the hand-camera as in the stand, perhaps more so, because most motions have to be made rapidly, and to follow each other rapidly. The next that is wanted is *handiness*, which includes

lightness, and excludes unnecessary bulk. Every motion of the hand-camera should be one performed with ease. It should be easy to place the plates or films in position in the camera; it should be easy to bring a plate into position ready for exposure, and especially to remove that plate after exposure, and to bring another into its place; it should be easy to see the view-finder or finders to adjust the diaphragm and set the shutter; and, above all, it should be easy to make the exposure at exactly the right instant of time, without jerking the camera.

Length of Exposure.—This is governed by exactly the same principles that govern the exposures with hand-cameras—see farther on Tables of Exposures—except that there is a limit or maximum with the hand-camera, practically none with the stand-camera. The longest I have heard of is *nine months;* the longest I have given was a day, and that turned out an under-exposure. Now, one cannot hold a camera steady in the hand for a day, let alone nine months. Indeed, the time that a camera can be held even in two hands, without the occurrence of angular motion great enough to show on the negative, is very short, for the steadiest hand is not absolutely steady, and the action of the heart and lungs, besides rythmic motions, sets up a slight tremor through the whole body. Besides which, the body, unless especially supported, as by leaning against a wall, is in instable equilibrium.

There are some persons who profess to be able to give an exposure of several seconds without resorting to any such assistance as leaning the back against a wall, pressing the camera against the chest and holding the breath. All I can say is, that I have never seen one of these remarkable individuals at work, and, to be very brief, that I consider $\frac{1}{10}$th second about the longest permissible exposure with a camera held in the hand.

The minimum exposure is limited by the powers of the shutter,

or by whether a sufficient exposure is within the possibilities of the lens and plate, or on whether the motion of the body photographed is not so rapid as to give a blurred image when the shutter is used at its quickest.

Subject.—Any that can be handled within the maximum and minimum exposures as above defined.

The Various Motions of the Hand-Camera, Drill, Alertness.—According to the make of camera, there may be any number from 2—"pressing a button," and turning a screw, or moving a lever to bring an unexposed plate or film into position—up to about 20. Taking an average hand-camera of high class, the following may be the motions, not of necessity in the exact order given. I assume, for the sake of definiteness, that the photographer is approaching a group in the street to photograph it, or, what makes the work more difficult, that the group is approaching a spot where he has taken his stand.

1. To decide whether a horizontal or vertical picture will be best, and to hold the camera accordingly.

2. To focus, guessing the distance at which the exposure will be made, and adjusting the camera accordingly by the aid of the distance scale with which every good hand-camera is fitted.

3. To put the right diaphragm in position.

4. To set the speed of the instantaneous shutter.

5. To withdraw or open the door of the dark slide, magazine, or roll-holder.

6. To sight the subject in the finder, keeping the camera horizontal in both directions.

7. To *expose* at the exact right instant of time.

8. To close the door of the slide, magazine, or roll-holder.

9. To get an unexposed plate in position for the next exposure.

10. To set the shutter for the next exposure.

It will be seen that the camera is left as nearly as possible

ready for a new exposure, and this should be strictly adhered to as a rule, till the plates or films are exhausted, so that only seven out of the ten motions have to be made in quick succession. Indeed, it needs great alertness and long practice to be able to make even the seven quickly enough, though it will be understood that some of them, as decision for horizontal or vertical, setting diaphragms and setting the speed of the shutter, may be made whilst the subject is still at some little distance.

The only way I know of to "learn" the hand-camera, is to use it on the stand (or placed on a table or the like) till each separate motion is mastered, then filling the slides or magazine with dummy plates to go through all the actions in their order in gradually increasing rapidity till the action becomes automatic. With the roll-holder, the milled head may be turned the requisite number of times.

There still remains to learn to *focus* in an instant and almost by instinct. This can only be acquired by a sort of "drill." The camera is held in the position for exposure whilst some object is approached. The photographer stops at any distance, immediately setting the focus, then verifying it by pacing to the object (this means of measurement is exact enough), or he stands still where there is an approaching object, and, when this is *nearly* large enough, focusses, and makes the exposure when the image is just right in the finder, notes the position of the object at that instant, and paces the distance. He will generally find that at first he persistently over-estimates or under-estimates the distance, but by going through the action many times—many *hundreds* of times—wonderful precision is obtained.

This may be the place to say a word about so-called "fixed focus" lenses, as these mis-named articles are more sold with hand-cameras than with any other. It should at once be understood that *there is no such thing as a fixed focus lens*, and that when a camera is sold as having a fixed focus *lens*, what is really meant

is, that the camera itself has a fixed focus, inasmuch as there is no focussing adjustment, and the gear is useless for all-round work. The most that can be said about the results of so-called "fixed focus" apparatus is, that if the size be very small, and the lens be one of but moderate full aperture—that is to say, be of but moderate speed—that lack of focus in all planes of the picture may not be noticeable unless enlarging is attempted, and this especially if the lens be of inferior make, so that no plane is quite sharp.

Position of the Camera.—Various workers advocate different methods of holding the camera. I may say that I prefer to hold it in both hands, and, as a rule, as high as the finder will permit. The camera may be pressed against the breast to increase steadiness. Many good hand-cameras for small work are made to be held as opera-glasses, one eye looking through, or at, a finder.

Much more might be written about the use of the hand-camera, but there is not space here. The great thing is practice, then more practice, and then more practice still. To become a really expert hand-camera worker, needs about as much practice of hand and eye as to become a rapid manipulator of a type-writer, and a good snipe shot.*

* All who aspire to this degree of perfection—or, indeed, who take up hand-camera work at all—should read Mr. Walter D. Welford's "THE HAND-CAMERA AND HOW TO USE IT," published by Iliffe & Son, St. Bride Street, London, E.C. Mr. Weldon is an expert, and was an enthusiast in hand-camera work long before it became nearly as popular as it now is. He believes that the use of the hand-camera will eliminate nearly all the vices that fall to the lot of poor weak humanity, and plant most of the virtues in their stead.

CHAPTER IX.

PORTRAITURE.

To take portraits—to secure likenesses of his friends—is sure to be an early ambition of the photographer. In fact, he will show self-denial above the average in foregoing his natural desire if his first attempt be not to "perpetrate a portrait." Nor is this to be wondered at, for, indeed, there is a charm in portraying the human face and form, quite other and much greater than there is in making pictures, ever so truthful and beautiful, of stones, and trees, and things without life. Nor need the amateur despair, now that he has at his command the wonderful powers of the dry plate, of reaching a certain proficiency. True, in this department of photography he need not, unless he have very exceptional ability and much perseverance, as in landscape work, aspire to compete with the professional, other than the third or fourth-rate one; still a portrait done by a friend is sometimes looked upon in a kindly spirit by the original, and valued for the sake of the portrayer. In one point the amateur has an advantage: the surroundings and operations are not likely to create the awe and nervousness that appear to overcome some sitters whenever they enter the formidable studio of the professional.

Portraits may be done either out-of-doors or in an ordinary room. I put on one side the possibility of the amateur having command of a studio.

Out-of-door portraiture calls for little remark. It is comparatively easy; but the results gained are not usually so pleasing as those of successful in-door work.

All that is necessary is to get a suitable place in which to operate. There must be some means of shutting off a portion of the top light. This may often be secured by taking advantage of the outspreading branches of a tree. The position chosen must be such that there will be a somewhat stronger light on one side of the sitter than on the other; by this means there are secured relief and roundness. If a full-length sitting or standing figure be attempted, a natural background, such as an ivy-covered wall, the stem of a large tree, or such like, is the best. If heads be done, an artificial background, such as will be described hereafter, should generally be used.

Very powerful, if generally somewhat rugged, portraits may sometimes be taken in full sunshine with an oblique light; but much skill is needed, otherwise they will be positively harsh.

The requirements for portraiture indoors are more complex. The chief of these is a head-rest. This is an instrument much abused by many; and, indeed, one that it would be good to do away with, but which, in the present condition of photographic knowledge, is still, in many cases, a necessity. The average sitter is unable to keep sufficiently steady without a rest for his head, and for his body if he be standing, during an exposure of longer than four or five seconds. Now, on consulting the Tables given further on, it will be seen that in a common room an exposure so short as this is secured only with the rapider forms of portrait lenses used with full aperture.* If a larger size than the carte, or at the most the cabinet, be attempted,

* Since this was written, the sensitiveness of plates has been so much increased that, by using the rapider brands, the head-rest can generally be dispensed with, even in an ordinary room. The very rapidest will work with $\frac{1}{10}$th the exposures given.

it will generally be found that so large apertures cannot be used, even if the lenses be at hand, because the depth of focus given thereby is so small. As regards lens, that known as the group, or D lens, or one of the rapid symmetrical or rapid rectilinear, is most suitable, unless the amateur possess a portrait combination. Even the "single lens" may be used if the aperture be increased to "8," an aperture at which many single lenses will work (see Tables, pages 101, 102, 103); but the exposure will be somewhat prolonged. Of course, any of the rapid NEW LENSES may be used if the *focal length in actual work be long enough.*

One thing is to be particularly mentioned in connection with the lens used for portraiture, either indoors or out: *it should be one of long focus*, otherwise the most unpleasant effects of exaggerated feet, hands (or in large heads, nose)—in fact, all the parts nearest the camera—will be the result. The focal length of the lens should be not less than about double the length of the trimmed print to be produced. Thus, for a carte, it should not be less than 7½; for a cabinet, not less than 12 inches. If this rule be observed, the distortion given by single lenses will be quite inappreciable.

A background of some sort is a necessity. Sometimes the walls of a room are suitable; but generally it is best to construct a special background. This may be done by making a light frame-work of wood, 7 feet by 5 feet, and stretching on it the coarse brown paper known as "carpet paper." This is done by damping the paper, so as to stretch it, then gluing it on the frame by the edges. Paper may be thus stretched with advantage on both sides of the frame; one side may be left the natural colour of the paper, and will do for dark backgrounds; the other may be painted of a light grey colour with "distemper," and will serve as a light background for heads to be "vignetted."

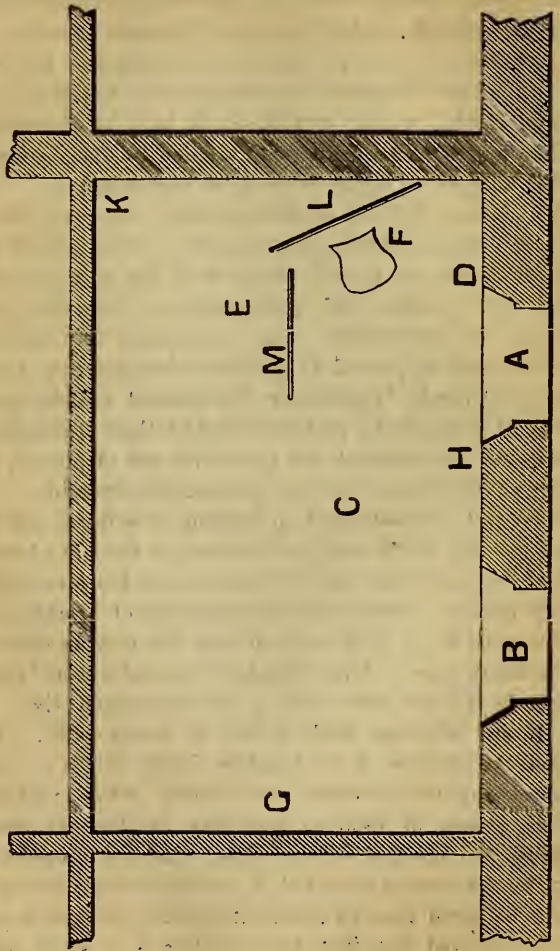
The amateur who has the necessary artistic taste and knowledge may produce scenic backgrounds to his heart's content. These are painted roughly in neutral distemper colours.

A reflector is a necessity for indoor portraiture. Its use is to relieve the heavy shadows on the side of the face that is away from the light. A sheet or table-cloth, held by an assistant, is sufficient; but a wooden frame, similar to the background, covered with white paper, is the most convenient.

The pose and lighting of the model are, of course, the chief points to which attention must be given. With regard to the first, the beginner should study well the pictures of good artists, both painters and photographers. One thing only I shall say on the matter. The so-common impression, that what the sitter is pleased to consider a free-and-easy pose will give a good result, is generally the greatest mistake possible. Nearly all photographic portraits in which there is an appearance of ease and unconstraint are the result, not of chance, but of study and intention on the part of an artistic operator.

The object to be attained in lighting is softness and roundness—avoiding on the one hand flatness, on the other harshness, such as is given if one side of the face be in too deep shadow—and to combine with this the maximum of brightness compatible with it. I shall explain how this may be obtained in any ordinary room. A sketch is here given of a room (page 90), 20 feet by 12 feet, this being a not uncommon size. At A and B are windows, each 3 feet 6 inches wide. Let us suppose the window B is closed by drawn blinds or curtains, or by closing the shutters; it is worth while noticing the various phases of lighting that may be brought about by changing the position of the sitter. Let an observer stand at C, the sitter being placed at E, and the reflector being used. It will be found that an excellent lighting, as regards quality, can be obtained, but that the quantity is so small that the

exposure would be extravagantly long. Now let the sitter



be placed at D. It will be found that the lighting is bright

and bold; in fact, too bold, for be the reflector used as it may, there is too deep shade in the far side of the face, and this will be even more apparent in a photograph than to the eye. A compromise must evidently be made. This may be done by placing the sitter at F. It will now be found that the lighting will be all that can be desired, whilst the exposure will not be much greater than with the model at D.

The spot where a soft and harmonious lighting is secured being determined, the next question is, from what direction is the portrait to be taken? For pleasing results may be got with anything between three-quarter light, one-quarter shadow, and one-quarter light, three-quarter shadow, the latter style of lighting having been given the name of "Rembrandt," although the name is a bad one, as Rembrandt used lighting of every kind. With a room of the shape and size shown, the choice is not great for full-length standing figures, as the camera will have to be kept far from the sitter, and towards the end of the room. With heads, however—in which particular form of portrait the lighting is, if possible, more all-important than in any other—the camera may have its position varied anything from H to K. Probably the most successful results will be got from H. If the position be approached to K with the object of getting "Rembrandt" effects, means must be taken to shade the direct light from the window off the lens. The background, L, and the reflector, M, are shown in position for a sitter at F, and for the camera about H. It is unnecessary to say that the reflector must be kept far enough away not to appear in the picture. It should, however, short of this, be kept as near as possible.

After posing, the head-rest should be adjusted. It must be distinctly understood that this appliance is not meant as a means of clamping up the model's head, but that it is intended as a rest to be brought into position after posing has been performed, so that the sitter may gently lean his head against it.

The reason for advising that one of the windows be closed is, that a double source of light is generally objectionable. It is liable to produce an unpleasant lighting in general, and almost always causes a false light in the eyes.

With regard to the taking of groups, my advice is to follow as closely as possible that given by *Punch* to young men about to marry—"Don't." An amateur seldom acquires the skill necessary to enable him to pose and light artistically one figure with any degree of certainty. It is enormously more difficult when there are several. If groups must be done, they are best done out-of-doors. Except for carte size, a lens with comparatively small aperture must be used for groups, so as to get all the figures in focus. This makes the exposure very prolonged in an ordinary room. Moreover, some of the figures must, in such a case, be much nearer the light than others.

In grouping out-of-doors, the figures near each end of the group should be brought somewhat nearer the camera than the others, as this will bring them into better focus. Several may, with advantage, sit down slightly in advance of those standing. If the photographer can prevent all the members of the group from gazing into the camera with a glassy stare, and cause them to turn towards each other as if in conversation, he will have accomplished much.

CHAPTER X.

TABLES TO FACILITATE JUDGMENT OF EXPOSURE.*

I GAVE, in the chapter on lenses, rules whereby it is possible to compare the rapidity of various lenses, and, having once determined for a certain subject the exposure for any one lens and stop, to estimate exactly what would be the exposure with any

* Violent objection has been made to these Tables by several photographers of great experience and of long practice, but I retain them nevertheless. These photographers of long experience seem to think that nothing that was not of use to them at the time they learned photography—because it did not exist, or for some other reason—cannot be of use to beginners of the present day. I have, however, had so many letters describing the use that the Tables have been to the writers at that time when anything that can assist the beginner to answer that most difficult question:—"How long shall I keep the cap off the lens?" is most welcome; that, apart altogether from the fact that I composed the first three for my own use, and used them for several years, I am still persuaded that the Tables are of some use. But I quite willingly admit—and, indeed, would emphasise the statement—that, as soon as the photographer's judgment has so far matured that he feels that he can rely on it alone, he should discard all artificial aids. I think, however, that it will generally be found that this ripening of the judgment in the matter of exposure is a thing that takes years; and, moreover, I do not find that the judgment of those who scorn such assistance as they can get from the first is by any means more quickly ripened than that of those who are willing to take advantage of it.

other lens and stop. The work involved is little and easy, but there are some who find even such difficult. For the sake of these I have compiled a set of Tables which, I believe, make it as nearly impossible to find any difficulty in estimating exposures as can be. I shall explain the use of them.

The Photographic Society of Great Britain has established a standard of rapidity for lenses. A lens with an aperture one-quarter its focal length ($f/4$) has been taken as the unit, and is called "1." A stop of half the area, which will necessitate double the exposure of this latter again, is called "2"; one needing double the exposure of this latter again is called "4"; and so on, 8, 16, 32, 64, 128, 256, this last being about the smallest aperture generally used in practice. Apertures larger than $\frac{1}{4}$ the focal length—which are rare—are signified by ·5, ·25. The latter is, I believe, the largest aperture possible to get in practice.

Now, it is evident that if all opticians were to adopt this standard, the estimation of exposures would be much simplified. Every stop would have on it a number signifying the rapidity of the lens when it was in use, and the same number would signify the same rapidity in the case of any lens. Moreover, the effect of using a stop one size smaller than another would always be to double the exposure.

Many manufacturing opticians have adopted the suggestion of the Photographic Society, but still a number of lenses in the market have not their stops adjusted in accordance with it.* Moreover, at least one optician has adopted the standard *sizes* for his stops, but numbers them according to some scheme of his own, very different from that recommended by the Photographic Society, whilst others have taken $f/\sqrt{10}$ as a unit, so that confusion is but rendered worse confounded. It is often, however, easy to alter stops so as to

* Doubtful at the present day.

accord with the standard. To enable any photographer to do so who wishes, a Table is given showing for any focal length of lens what are the diameters to which it is necessary to cut the stops. Referring to Table I., we find, for example, that with a lens of 9 inches focal length the aperture "1" will be 2·25 inches, that is, 2¼ inches. It is only possible to get such an aperture with a portrait lens, and if the lens in question be not such, we must pass on to "2"; here we find 1·59 inches still only possible with a portrait lens, with some group lenses, or with some of the new forms of extra-rapid rectilinears already mentioned. "4" we find is 1·12. This is a possible aperture with group lenses, and most modern rapid landscape lenses; the next, "8," is ·80 inches, and is an aperture to be had in all lenses of the rapid rectilinear or rapid symmetrical type. "16" is ·56 inches, and may be had in "single" lenses of modern patterns; "32" is ·40, and may be had in any single lens; "64" is ·28 inch; 128 is ·20 inch; and 256 is ·141 inch.

In the case of a portrait lens, we should thus make our largest aperture 2¼ inches, and call it "1" (unless, that is, we were able to get an aperture of 3·18 inches, which we would call ·5), and the others 1·59 inches, 1·12, and so on, down as small as we pleased. In the case of a group lens, our largest stop might be 1·59, or rather more than 1½ inches. We would, however, not call this "1," because it is the first stop of this particular lens in question; but "2," because the aperture is *f*/5·657. In a single lens our largest would probably be ·56 inches, and would be marked 16. This gives the diameters to which to cut the movable stops of a lens, but the fixed stop of a lens should never be *contracted* simply to make it agree with one of the standard numbers. It should be left as it is, if it does not agree with a standard number, and should be marked with an odd number got from Table III., as will be explained.

For any lens whose focal length is *half* that of one given in

the Table, the aperture must be divided by two. For one with twice the focal length of any mentioned, they must be *multiplied* by two, for three times by three, and so forth. It is thus possible, by mere reference to the Table I., to cut a set of stops to the standard sizes for any lens. In its original form this Table was made out more than twenty years ago for my own use. It was not published till several years later, and even then was, so far as I know, the first in the field. From the time it was first written to the present, it has not, if I remember rightly, been altered in any way. But with the present edition I make a radical change. The rapidity of plates during these years has increased so very greatly that I have had no hesitation in reducing exposures to about *one-fifth* of what they at first stood at. I have also added a column headed "Brightly-Lighted Street Scenes"—this in special consideration of the hand-camera worker.

We now take Table II. This needs no great explanation. In it will be found the necessary exposures for most subjects with all standard apertures of the Photographic Society.

Table III. is not quite so readily understood. I have explained how to cut a set of stops to the standard sizes for any lens, but it is quite possible that some may not have the inclination to do so, or the means therefor. For such this Table is intended. Anyone can, by its use, take any lens, and by merely measuring the stops, say what relation there is between the area of each one, and of such a stop as would form the Great Britain Society's unit.

Let us take an example. I suppose once more that we have a portrait lens of 9 inches focal length, and that we do not wish to make a new set of stops, but that we wish to find out for each stop what ratio its area bears to one that would form the unit of the Great Britain Society's standard stops, or, in other words, would measure in diameter one-quarter the focal length

of the lens, and would be styled "1," or *f*/4. Say the full aperture of the lens is 2½ inches, and the other stops 2 inches, 1½-inch, 1-inch, and ½-inch. On the Table, opposite 9 inches focus and 2½-inch aperture, we find ·81, that is to say, the lens will require an exposure of ·81, or about four-fifths of a second, where one working with an aperture "1," or *f*/4, will take one second.

Opposite 2 inches in the same line we find 1·24. With this stop the exposure will be 1·24, or (say) one and a-quarter times as long as with a lens working *f*/4. The figures opposite the other apertures mentioned are 2·28, 5·06, 20·2. With these stops the lens will need exposures 2·28, 5·06, and 20·2 times as long as will a lens working *f*/4, which, as has already been mentioned, is said to have the aperture "1."

I shall now explain the working of Tables III. and II. together, by taking a set of examples.

Let us suppose that we have a single landscape lens of 8 inch focus, that the subject we are about to photograph is a landscape with deep shadows and dark foreground, and that the stop which, out of those with which the lens is provided, gives the best result is ¼-inch diameter. In Table III. we find opposite 8-inch focal length, and under ¼-inch aperture, "64." We now turn to Table II. Opposite "64" (or *f*/32) we find for landscape with heavy foliage in the foreground 1⅗ seconds. This, therefore, is the exposure which we have to give.

Again, suppose the lens and subject the same, but the aperture only $\frac{3}{16}$-inch. We find in Table III., opposite 8 inches focal length and under $\frac{3}{16}$-inch, "114." Now we will not find any such aperture as "114" in Table II., that number not being one of the standard ones. The nearest we can find is "128," which is somewhat too large. We find opposite it an exposure for landscape, with heavy foliage in the foreground, 3⅕ seconds. Strictly speaking, we ought to work out a proportion sum thus:—128 : 114 : : 3⅕ seconds : the exposure needed,

which we will find to be 2·83 seconds. In practice, of course, there is no need of any such accuracy; we simply notice that as the aperture is somewhat larger than the standard one, the exposure will therefore be a little shorter—say, 3 seconds.

Yet another example. Suppose a "rapid" landscape lens, focus 10 inch, stop $\frac{7}{8}$-inch, to be in use, the subject a portrait out of doors. In Table III. we do not find $\frac{7}{8}$-inch among apertures. Let us take the nearest on each side of this—namely, $\frac{3}{4}$-inch and 1 inch. We find under $\frac{3}{4}$-inch 11·1, under 1 inch 6·25. Now neither of these figures is to be found as a standard aperture in Table II., but lying between them, as $\frac{7}{8}$-inch lies between $\frac{3}{4}$-inch and 1 inch, is the standard number "8." It will be quite near enough to take the aperture as this, and to take the exposure which we find opposite it—namely, $2\frac{2}{3}$ seconds; or, say, $2\frac{1}{2}$.

Another thing must be mentioned. In case of portraits, when large heads are done, or in any case where subjects very near the lens have to be taken, the camera has to be drawn out to a considerable distance, possibly several inches. The focal length of the lens is, in fact, increased for the particular subject. This has to be taken into account in judging of the exposure.

We shall take an example of this. Let us suppose a 12-inch focus portrait lens used with an aperture of 2 inches, the subject being a portrait indoors. We find that this aperture is, according to Table III., 2·25; the exposure will therefore be somewhat more than that opposite "2" in Table II. This, for a portrait indoors, we find to be $1\frac{1}{3}$ seconds; we would therefore require (say) $1\frac{1}{2}$ seconds.

Let us suppose, however, a head one-third life-size to be attempted. It will be found that the camera has to be extended till the focus is 16 inches. Referring to Table III., we find that with a lens of 16 inch focus, 2 inches aperture is equal to

standard number "4," and, referring to Table II., we find that an exposure of $2\frac{2}{5}$ seconds will now be needed.

Table No. IV. was compiled by Dr. J. A. Scott, who communicated it to the Dublin Photographic Society. It works in conjunction with Table II. The exposures in Table II. are for the very best light—that is to say, for that of the middle of the day in May, June, or July. Table IV. shows by how much it may be necessary to multiply the exposure given in Table II. for any hour any month of the year.

I shall explain the working of these two Tables together.

We are about to photograph an open landscape at five o'clock on an August afternoon; the lens we are using is a single achromatic, and we are working with stop No. 128, or *f*/44·25. In Table No. II. we find in the column headed "open landscape," and in the line beginning 128, $\frac{2}{5}$ second. Now, referring to Table IV., we find in the column headed "April or August" (the exposures being the same for either of these months), and in the line beginning 7 or 5 (that is to say, 7 a.m. or 5 p.m., at both which hours the light is the same), the figure 3. This means that the exposure found in Table II. is to be multiplied by 3. We found in Table II. $\frac{2}{5}$ second—$\frac{2}{5} \times 3 = 1\frac{1}{5}$; therefore, a full second is the exposure to be given.

It must be understood that Table II. is only approximate. Thus plates vary considerably in sensitiveness. The Table exposures will be found suitable for plates of good, but not extraordinary rapidity. The rapidest plates commonly to be had on the market will do with half these exposures, whilst occasionally plates are met with that will be fully exposed with one-third. Again as to subject. Very often subjects do not come precisely under the headings given. The column headed "brightly-lighted street scenes" was added with a special view to hand-camera work. The very best conditions are supposed to exist. Even with the brightest sunshine the exposures must

be doubled if there is any large area of shadow, or the rapidest plates procurable must be used. By an open landscape is meant such a subject as shows broad exposures of sunlight without any deep shadows near the camera. River scenes with trees in the distance, and such like, come under the heading.

By the "interiors" is meant such subjects as cathedrals and churches. They need very careful treatment, as there is likely to be a greater range of light than can well be registered by a photographic film.

When interiors are to be done, it is well to "back" the plate, by floating the glazed side of a piece of glazed black paper in a mixture of one part of water with four or five of glycerine, and by bringing the wet paper into contact with the back of the plate.

With regard to "portraits in ordinary rooms," I explained that, under the most propitious circumstances, the exposures may be reduced to half those given, which are on the assumption of an average-sized window, without houses or trees opposite it.* If there be opposite the window anything to obscure much of the sky, the exposure will have to be greatly protracted.

No rule can be given for exposures in dull and foggy weather; but it may be said that they often need to be much more protracted for such than the beginner would at first imagine.†

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* With the rapidest plates, and a very large window, I have known it to be reduced to $\frac{1}{6}$th of the figures given.

† For the convenience of photographers, the Tables, and most of the general information contained in this chapter, have been put into a compact form, along with space for notes, in a pocket-book entitled "Burton's Note-Book for Photographers." 1s. Messrs. Carter & Co., 5, Furnival Street, Holborn.

TABLE I.

Focal Length	6 ins.	6½ ins.	7 ins.	7½ ins.	8 ins.	8½ ins.	9 ins.	9½ ins.	10 ins.	11 ins.
Standard No. ·25	3	3·25	3·5	3·75	4	4·25	4·5	4·75	5	5·5
·5	2·12	2·3	2·47	2·65	2·82	3·01	3·18	3·36	3·53	3·89
1	1·5	1·62	1·75	1 87	2	2·12	2·25	2·37	2·5	2·75
2	1·06	1·15	1·23	1·32	1·41	1·50	1·59	1·68	1·77	1·94
4	·75	·81	·87	·93	1	1·06	1·12	1·18	1·25	1·37
8	·53	·57	·62	·66	·71	·75	·80	·84	·88	·97
16	·37	·40	·44	·47	·5	·53	·56	·59	·62	·69
32	·26	·28	·31	·33	·35	·38	·40	·42	·44	·49
64	·188	·20	·22	·23	·25	·26	·28	·29	31	·34
128	·132	·144	·155	·168	·177	·188	·20	·21	·22	·24
256	·094	·101	·109	·117	·125	·133	·141	·148	·156	·172

TABLE II. (Revised and Enlarged.)

Aperture calculated on Standard System of Photo. Society.	Sea and Sky.	Open Landscape.	Brightly-Lighted Street Scenes.	Landscapes With Heavy Foliage in Foreground.	Under Trees, up to	Fairly Lighted Interior, up to	Badly Lighted Interiors, up to	Portraits in Bright Diffused Light out of doors.	Portraits in Ordinary Room.
	secs.	secs.	secs.	secs.	min. sec.	min. sec.	hrs. min.	secs.	secs.
·25, or $\frac{f}{2}$ ...	$\frac{1}{3200}$	$\frac{1}{1200}$	$\frac{1}{400}$	$\frac{1}{100}$	0 $\frac{1}{2}$	0 $\frac{1}{2}$	0 $\frac{1}{10}$	$\frac{1}{100}$	$\frac{3}{20}$
·5, or $\frac{f}{2\cdot825}$ ...	$\frac{1}{1000}$	$\frac{1}{600}$	$\frac{1}{200}$	$\frac{1}{80}$	0 1	0 1	0 $\frac{1}{5}$	$\frac{1}{80}$	$\frac{3}{10}$
·1, or $\frac{f}{4}$ ...	$\frac{1}{800}$	$\frac{1}{300}$	$\frac{1}{100}$	$\frac{1}{40}$	0 2	0 2	0 $\frac{2}{5}$	$\frac{1}{30}$	$\frac{3}{5}$
2, or $\frac{f}{6\cdot57}$ ...	$\frac{1}{400}$	$\frac{1}{150}$	$\frac{1}{50}$	$\frac{1}{20}$	0 4	0 4	0 $\frac{4}{5}$	$\frac{1}{20}$	$1\frac{1}{5}$
4, or $\frac{f}{8}$ ...	$\frac{1}{200}$	$\frac{1}{75}$	$\frac{1}{25}$	$\frac{1}{10}$	0 8	0 8	0 $1\frac{3}{5}$	$\frac{1}{10}$	$2\frac{2}{5}$
8, or $\frac{f}{11\cdot314}$ ..	$\frac{1}{100}$	$\frac{1}{38}$	$\frac{1}{12}$	$\frac{1}{5}$	0 16	0 16	0 3	$\frac{2}{10}$	5
16, or $\frac{f}{16}$ ...	$\frac{1}{50}$	$\frac{1}{19}$	$\frac{1}{6}$	$\frac{2}{5}$	0 32	0 32	0 6	$\frac{2}{5}$	10
32, or $\frac{f}{22\cdot627}$	$\frac{1}{25}$	$\frac{1}{10}$	$\frac{1}{3}$	$\frac{4}{5}$	1 4	1 4	0 13	$\frac{4}{5}$	20
64, or $\frac{f}{32}$ ...	$\frac{1}{12}$	$\frac{1}{5}$	$\frac{2}{3}$	$1\frac{3}{5}$	2 8	2 8	0 25	$2\frac{3}{5}$	40
128, or $\frac{f}{44\cdot25}$	$\frac{1}{6}$	$\frac{2}{5}$	$1\frac{1}{3}$	$3\frac{1}{5}$	4 16	4 16	0 50	5	80
256, or $\frac{f}{64}$	$\frac{1}{3}$	$\frac{4}{5}$	$2\frac{2}{3}$	$6\frac{2}{5}$	9 2	9 2	1 40	10	160

A, B, C — Old Lenses. D, E, F, G — New Lenses.

Old Lenses.—A—Portrait Lenses; B—Rapid Landscape Lenses and Universals; C—Wide-Angle and Single Achromatic Lenses.

New Lenses.—D—Extra Rapid Lenses; E—Very Rapid Lenses; F—Rapid Lenses; G—Single Anastigmatic Lenses and Wide-Angle Lenses.

TABLE III.

Ins. Diam.	¼	⅜	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾	2	2¼	2½	2¾	3	3½	4	4½	5
3 Ins.	144	64	36	16	9	4	2·25	1·44	1	·562	·36	·25										
3½	196	87·1	49	21·8	12·2	6·45	3·06	1·6	1·36	·766	·49	·34	25									
4	256	114	64	28·4	16	7·11	4	2·56	1·78	1	·64	·444	·326	·25								
4½		146	81	36·5	20·2	9·12	5·06	3·24	2·28	1·26	·81	·57	·413	·316	·25							
5		178	100	44·4	25	11·1	6·25	4	2·78	1·56	1	·694	·51	·39	·309	·25						
6		256	144	64	36	16	9	5·76	4	2·25	1·44	1	·738	·562	·444	·36	·25					
7			196	87·1	49	21·8	12·3	7·84	5·4	3·06	1·96	1·36	1	·765	·605	·49	·34	·25				
8			256	114	64	28·4	16	10·2	7·11	4	2·56	1·78	1·3	1	·790	·64	·444	·326				
9				146	81	36·5	20·2	13	9·12	5·06	3·24	2·28	1·65	1·24	1	·81	·57	·413				
10				178	100	44·4	25	16	11·1	6·25	4	2·78	2·04	1·56	1·25	1	·694	·510				
11				215	121	53·8	30·2	19·4	16·4	7·56	4·84	3·38	2·47	1·89	1·49	1·21	·845	·617				
12				256	144	64	36	23	16	9	5·76	4	2·96	2·25	1·78	1·44	1	·738	·562			
13					169	75·1	42·2	27	18·8	10·6	6·76	4·69	3·45	2·64	2·09	1·69	1·17	·863	·66	·521		
14					196	87·1	49	31·4	21·7	12·2	7·86	5·4	4	3·06	2·42	1·96	1·36	1	·765	·605		
15					225	130	56·2	36	25	14	9	6·25	4·59	3·51	2·78	2·25	1·51	1·15	·878	·694		
16					256	111	64	41	28·4	16	10·2	7·11	5·21	4	3·16	2·56	1·78	1·3	1	·79	e	
18						146	81	51·8	36·5	2·2	13	9·12	6·61	5·06	4	3·24	2·28	1·65	1·24	1	·81	
20						178	100	64	44·4	25	16	11·1	8·16	6·25	4·94	4	2·78	2·04	1·56	1·23	1	

TABLE IV.

Hour of Day. A.M. P.M.	June	May or July	April or Aug.	Mar. or Sept.	Feb. or Oct.	Jan. or Nov.	Dec.
12	1	1	1½		2	3½	4
11 or 1	1	1	1½	1½	2½	4	5
10 or 2	1	1	1¼	1¾	3	5	6
9 or 3	1	1¼	1½	2	4		*16
8 or 4	1½	1½	2	3	*10	—	—
7 or 5	2	2½	3	*6	—	—	—
6 or 6	2½	*3	*6	—	—	—	—
5 or 7	*5	*6	—	—	—		—
4 or 8	*12	—	—	—	—		—

* The accuracy of these figures will be affected by a yellow sunset.

CHAPTER XI.

SECOND LESSON IN DEVELOPMENT.

In considering the subject of exposure in a former chapter, we assumed that correct exposure is a fixed point, and that any deviation from it would give imperfect results. This is scarcely the case, however, for there is a certain "latitude," which is due to two causes: first, a certain latitude of *effect* is permissible. Thus, if the plate be a little under-exposed, there will be somewhat less detail in the resulting picture than is visible to the eye; but this need not altogether spoil it. Again, if the plate be somewhat over-exposed, the effect will be a slight fog or want of transparency in the shadows of the negative; but the only result of this will be that what is called a "slow printing" negative is produced. The latitude in effect is not great, however. It may be said that if two seconds be the best exposure, anything between one and a-half and three, or perhaps four, seconds will give good results without modifying the developer. We have, however, a second method of gaining latitude, and this is by means of the treatment with the developing solutions. Thus, with any developer, simply by leaving the plate for a longer or shorter time in the solution, we can compensate to a certain extent for under or over-exposure. It is, however, by varying the proportions of the ingredients of the

alkaline developer that we gain the greatest latitude. Such a developer, one of many, must be described, its constituents being enumerated, and the functions of each of them being described. I take the old alkaline pyro, for the number of new developers that have come before the public in the last ten years or so is almost beyond belief; and though many of them offer advantages for particular kinds of work, I still consider our old friend pyro the best all-round developer we have, in spite of its nasty habit of staining the fingers and pretty well everything else that it comes in contact with.

The essentials of this developer are as follows:—First, pyrogallic acid, or more properly, pyrogallol; and second, carbonate of potash or of soda, liquid ammonia, or some other alkali.

With pyrogallic acid and an alkaline carbonate only in solution, it is quite possible to conduct development; but a soluble bromide, generally bromide of ammonium or of potassium, is used at times along with these to more completely control the action, and such is indeed essential where ammonia or another caustic alkali is used. It is also now an almost universal custom to have a certain quantity of sulphite of soda (first introduced by Mr. Herbert Berkley) or of meta-bisulphite of soda (first introduced by Swan) in the developer, as such prevents the rapid darkening by absorption of oxygen from the air, and consequent staining of the negative that is otherwise liable to take place. If the sulphite, or meta-bisulphite, be mixed up with the pyrogallic acid as recommended in the description of "stock solutions" in the beginning of this book, the result is a very convenient concentrated solution that will keep, ready for use at any time, for several months.

The pyrogallic acid is the true developer, and acts very energetically when rendered alkaline. The stronger the developer is in pyrogallic acid—up to a certain point, at any rate—the denser or more opaque will be the negative; and, as a consequence,

the stronger will be the contrast between light and shade in the resulting print.

The carbonate of potash, or other alkali, is used to render the developer alkaline, and the greater the quantity in the solution, the more energetic the action. The effect of increasing the alkali is to shorten greatly the time of development, to increase to a slight extent the amount of detail, and, up to a certain point, to increase the density. A point is reached, however, where the action is so energetic as to reduce or blacken even those parts of the plate which have not been acted on by light, and fog is the result. Some plates will stand much more alkali than others.

The use of the bromide is to retard development—to make it slower, so that it may be more under control. A developer with carbonate of potash or of soda is comparatively slow, even without any bromide, and the latter is, therefore, not needed in normal circumstances; but with ammonia or other caustic alkali, the action, without any bromide, would be so rapid as to be quite beyond control. The result of increasing the bromide is to make the developer much slower, to keep back a little of the detail, as well as any slight tendency to fog* that the plate may show, and to increase ultimate density greatly.

The function of the sulphite of soda is merely to prevent discoloration of the solution, and consequent staining of the negative. In moderate quantities it may be said that it is quite neutral as concerns the actual development, but, if used in too great quantity, it tends to reduce the opacity of, or contrast of, the negative. The citric acid given in the stock solution of pyrogallic acid (Chapter II.) is used merely to insure the neutrality, or slight acidity, of the sulphite of soda, a salt nominally

* A really foggy plate—one that is too old, for example—cannot be saved by bromide, but many plates that are really excellent show a slight veil without it, none with it.

neutral as sold, but that is generally, as a matter of fact, somewhat alkaline. If it is in this condition, it does not perform its function of preserving the pyrogallic acid solution efficiently. Various other acids besides citric acid may be used.

A little consideration of what has been said will show that by varying the proportions of the constituents enumerated, we have the power of greatly modifying the resulting negative, and have a power of compensating, to a considerable extent, for error in exposure. This is especially the case for over-exposure. It is true that in the case of under-exposure we can correct, to a certain extent, by using an increased quantity of alkali; but the fog point is soon reached, and thus it is only slightly that we can correct in this direction. It would, perhaps, be nearer the point to say that a good plate will stand some straining, just as a good boiler *may* be forced above its intended working pressure to a moderate extent. Your good boiler will probably not burst, and your good plate will probably not fog, but there is certainly a bursting pressure for the boiler, and a fogging point for the plate. In the case of over-exposure, however, it is different; bromide may be added indefinitely. By using a large quantity of bromide the development is rendered slow as regards the appearance of detail, *but less so as regards the increase of density.* It is thus possible to stop the process in the case of an over-exposed plate before the shadows veil over, and yet to have a sufficiently dense negative.

It is right, in using any particular make of plates, to use the developer recommended in the "instructions"; but it is by no means necessary to mix the "stock solutions" exactly as directed. On analysing any of the sets of stock solutions given, it will be found that they consist essentially of the chemicals mentioned before, or some equivalents, made up in solutions of certain strengths, and nearly always with some preservative—generally sulphite of soda, in the case of the pyrogallic solution—to prevent

its turning brown by oxidation. In almost every case there is a most needless complication introduced, which makes considerable calculation necessary to find what quantity of each chemical really is in an ounce of the final developer. There can be no simpler plan than to mix all solutions used for development so that each shall contain ten per cent. of one of the ingredients; the mixture of pyro, sulphite of soda, and a little acid being looked on as a ten per cent. solution of pyrogallic acid only. Any developer can then be made up in any proportion without trouble, and that given in any instructions can be used without the intervention of complicated formulæ.

To carry out the development of all kinds of plates exposed on all kinds of subjects, it is necessary to have, in addition to the stock solutions mentioned in Chapter II., only a ten per cent. solution of bromide of ammonium, or, better, except where ammonia is the alkali, bromide of potassium. This is made by taking one ounce of bromide of ammonium or bromide of potassium,* and making up the quantity to ten ounces with water.†

There is no developer that is suitable for all subjects and plates, not necessarily as regards ingredients, but as regards proportions of these. Those given in instructions can only be taken as typical. If the photographer expect to excel, he must vary his developer to suit his subject and plate. Thus, when the contrasts in the object to be photographed are very strong—say in the case of an interior

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* The relative efficiency of the two bromides as restrainers is about :—

Bromide of ammonium	1
Bromide of potassium	·63

The relative quantities to be used are therefore about :—

Bromide of ammonium	1
Bromide of potassium	1 6

† Bromide of potassium ... ... 50 grammes
Water to make up to ... ... 500 c.c.

with white columns and deep shadows—he must reduce the amount of pyro, or he will have a negative giving a "chalky" print.

If the contrasts are naturally weak, as is sometimes the case in open landscape, he must increase the quantity of the pyro, and perhaps add a little bromide. If he know that he has under-exposed, he must increase the alkali. If he know that he has over-exposed, he must increase the bromide.

The developer given in Chapter V. is somewhat weaker in alkali than is generally recommended, and is, consequently, a somewhat slow developer. The slowness is a decided advantage, at least at first. There are many who prefer at all times to use but little alkali, allowing the image to develop very gradually, the reason being that they believe that they thereby get a higher quality of negative in the end. There can be no doubt, however, that with most plates, and when the photographer is certain that his exposure is correct, it is permissible to use considerably more alkali even from the first. The following may be taken as a normal developer for average subjects, when correctly exposed, on most kinds of plates:—

Ten per cent. solution of pyrogallic acid ...20 to 25 minims
Ten per cent. solution of carbonate of potash 100 ,,

To each ounce of developer needed.*

The time taken for development with this developer will be only two-thirds or three-quarters of that with the developer given in Chapter V.

If, as is generally the case in landscape work—at least, in the case of the first plate developed of a number that have been exposed at the same time—there is uncertainty as to whether

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* Ten per cent. solution of pyrogallic acid ... ... 2 c.c.
Ten per cent. solution of carbonate of ammonium ... 10 c.c.
Water to make the solution up to ... ... 50 c.c.

the plate has been exposed correctly or not, it is best to begin with a developer very weak in alkali, and to add more afterwards if it appear to be needed. The following is the sort of developer that should be first flowed over a plate when there is uncertainty of the kind mentioned:—

Ten per cent. solution of pyrogallic acid ...20 to 25 minims
Ten per cent. solution of carbonate of potash 30 ,,

To each ounce of developer needed.*

This is a very slow developer, and even if the plate be much over-exposed, the image will not appear for some time. A little experience will enable the photographer to know, by the length of time which elapses between the time of pouring on the developer and the appearance of the image, and by noticing how the detail begins to come up, whether the plate has been over-exposed, correctly exposed, or under-exposed. If the exposure appears to be correct, ten per cent. solution is added a little at a time (say 20 minims) till the detail is all out. The addition is best made by pouring the additional potash solution into the developing cup, pouring the developer from the dish back into the cup, and when thorough mixture takes place, flowing again over the plate.

If it appears to be over-exposed, development is proceeded with, or some bromide of potassium—say ten minims of the ten per cent. solution to each ounce of developer—is added. If the image be very long in appearing, showing that there has been under-exposure, alkali may be added to any amount short of that which will produce fog. Good plates should stand 200 minims to the ounce of ten per cent. of carbonate of potash without fogging.

A few words should be said on the development of plates

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* Ten per cent. solution of pyrogallic acid ... ... 2 c.c.
Ten per cent. solution of carbonate of potash ... 3 c.c.
Water to make the solution up to ... ... 50 c.c.

that have received instantaneous exposures, and on which portraits have been impressed.

In the case of most subjects that are suitable for instantaneous work, the brightness of the object is very great, but the *contrast* of light and shade is often comparatively small, as even the shadows reflect a good deal of light. For this reason there is sometimes great difficulty, not only in getting detail in the shadows, but also in getting density. The thing necessary to get both is great patience in continuing development for a very long time with a very slow developer; that is to say, one in which the quantity of alkali is rather below than above the normal quantity, and that of the pyro somewhat high.

The dish must be rocked at least every ten seconds or so during the development, which may often with advantage be continued for a quarter or even half-an-hour.

When development is protracted for a very long time, the dish should be covered to protect it from light, except when it is necessary to look at the plate.

Concerning portraits, I may say that for the development of those taken out-of-doors, no particular precaution is necessary. In those taken in an ordinary room there is always a tendency to hardness or chalkiness, and for this reason it is generally well to keep the pyro somewhat below the normal.

It used to be commonly said that there is difficulty with gelatine plates in getting a dense enough image. Where good plates are used, such a difficulty results only from ignorance of the principles of development. The secret of getting vigorous negatives lies in plenty of patience, beginning only slowly with but a small quantity of alkali, and if we are at all doubtful about getting sufficient density, in giving, perhaps, a slightly longer exposure than might otherwise be thought necessary. The real difficulty lies in judging when the density is sufficient, for it always appears greater before fixing than afterwards.

CHAPTER XII.

VARIOUS OTHER DEVELOPERS IN USE.

Until about fifteen years ago we had only two developers for dry plates, the alkaline pyro (nearly always with ammonia as an alkali) and the ferrous oxalate. Then there came hydroquinone, discovered by Captain Abney, and hydroxylamine by Mr. A. Spiller. Then, ten years or so ago, there came eikonogen. Ferrous oxalate is still much used, especially for developing prints. Hydroquinone is an excellent developer, and is a favourite with many; but I believe hydroxylamine is now never used—the name was, perhaps, enough to condemn it. Eikonogen is a very good developer, though it has not done all the miraculous things that were promised of it.

Eikonogen was the first of a perfect shower of new developers—all, I believe, coal-tar products—which are being invented in numbers to daze even the most enthusiastic experimentalist, and the cry of which is, "still they come!" Of nearly every one, as it makes its appearance, the claim is put in that it is the *best* of any, and that it will allow the exposure to be reduced to one-third of that with any other developer, which claim is speedily disproved, for there is *no* "best" developer, unless it be pyro. Each, however, has its good points. Mr. Andrew Pringle and Mr. C. H. Bothamley, both very high authorities, have been experimenting with one of the latest developers,

"Ortol"; and Mr. Pringle says of it, "In 'Ortol' I find a simple, lasting, non-fogging developing agent, with an adaptability to circumstances distinctly a-head of any agent we have had *since pyrogallol*" (italics mine).

I also still prefer the pyro developer, and advise the beginner to give it a very thorough trial before rejecting it for any other, *judging by the prints that result, not by the appearance of the negatives.*

A description of a few different kinds of developers is here given; but to describe all would mean doubling the size of this book, even if I had tried them all, and of some of the latest I have not yet had even a sample.

The Ammonia Developer.—A developer in which the alkali is ammonia was that by far the most generally used in England until within the last ten years, and there are still many who prefer ammonia to the alkaline carbonates. It has, indeed, the advantage that development can be finished with great rapidity, and that is an unmistakable advantage in the case of a professional portrait photographer, but is of little or none in the case of an amateur. There are some plates that give more detail with ammonia than with any other alkali, but such is certainly not the general rule. On the other hand, ammonia has the distinct disadvantage of producing colour fog (for a description of which see next chapter) with some plates, and especially if the attempt be made to force development in the case of under-exposure.

The following will be found to be a good developer for general work:—

Ten per cent. solution of pyro ...	10 to 20 minims
Ten per cent. mixture of ammonia and water	25 ,,
Ten per cent. solution of bromide of ammonium...	10 ,,

To each ounce of developer needed.*

The ten per cent. solution of pyro may be the same as that used with potash, or may simply be made up as follows:—

Pyrogallic acid	1 ounce
Citric acid	¼ „
Water to make the solution up to ...	10 ounces†

If the latter be used, the negatives got will not, as a rule, be black, but of a brownish colour that does not look very well, but that has excellent printing qualities.

The ten per cent. mixture of ammonia and water is made by taking one ounce of the strongest ammonia, or two ounces of the ammonia diluted with an equal quantity of water, as recommended in Chapter II., and making up the quantity to ten ounces.

The Soda Developer.—The action of carbonate of soda in the alkaline developer is very similar to that of carbonate of potash, but that it makes a somewhat slower developer if the same quantity only is used, and that it tends, on the whole, to give denser negatives. It may be used in precisely the same way as the potash, a ten per cent. solution of good washing soda being made up. This should be used in quantities nearly double those recommended for the potash solution. Indeed, I have known plates that would stand development with a mixture made up of the stock solution of pyro and a ten per cent. solution of carbonate of soda without further dilution.

I have found good quality washing soda to be quite satisfactory

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* Ten per cent. solution of pyro	1 to 2 c.c.
Ten per cent. mixture of ammonia and water ...	2 to 3 c.c.
Water to make the whole quantity up to ...	50 c.c.
† Pyrogallic acid...	40 gr.
Citric acid	10 „
Water to make the solution up to	400 c.c.

in its action, in spite of the fact that, as there is liable to be a variation in the quantity of water of crystallization, it is not possible to have a solution of absolutely fixed strength. Some prefer, on this account, to use the anhydrous carbonate of soda, which has no water of crystallization. If a ten per cent. solution of this be used, it should be borne in mind that it is a little *stronger* than a ten per cent. solution of carbonate of potash, and that, therefore, rather *less* of it should be used.

The Hydroquinone Developer.—This developer has of late become a great favourite with many. Its action is similar to that of pyro, but it is not so liable to stain, and it gives a negative with very clear shadows and of a beautiful black colour of deposit. Even with an alkaline carbonate, it will, with some plates,* give more detail than pyro, but this is an exception to the rule. With either caustic or caustic potash it often will, and a great stimulus was given to the use of hydroquinone by the publication of a paper on the subject by Mr. J. W. Swan in 1889. In that paper he first suggested the use of caustic alkali with the substance. The following is the exact developer that he recommends for normal exposures :—

Hydroquinone	2 grains
Sulphite of soda	6 ,,
Citric acid	¼ grain
Caustic potash	6 grains
Bromide of potassium	¼ grain

* A great deal of the difference of opinion that exists as to which is the best developer arises from not taking into consideration the fact that what is the best developer for one kind of plate is not by any means of necessity the best for all kinds. This conclusion is the result of many comparative experiments. As an example, I prefer pyro to any other developer in most cases, but I know of plates *that will not give even a fairly good negative with pyro* that will, nevertheless, give excellent results with hydroquinone and an alkaline carbonate.

To each ounce of developer needed.*

This developer is very active, especially if the quantity of caustic potash be increased. Indeed, in the case of "robust" plates—that is to say, plates that need a great deal of pushing before fog will appear where there has been no exposure to light, and which will not frill—the exposure may be reduced to one-half, taking that needed with pyro as 1. Unfortunately, the rapidest plates are seldom of this character, and then only when new. If we can, however, as is sometimes possible, get hold of a plate that is of the highest rapidity, and also "robust," our powers in the matter of instantaneous work—hand or stand—are greatly increased by the use of this developer.

The use of carbonates in connection with hydroquinone has been mentioned. Hydroquinone may simply be used instead of pyro, with the result of a developer that is slow, but that gives negatives that are very clean and of a fine colour. See above for the quantities of carbonate of potash or soda. One thing is to be observed, however, and that is that it is not possible to make a ten per cent. solution of hydroquinone, as it is not sufficiently soluble. It is, however, possible to make a five per cent. solution in the following manner. An ounce and a-half of sulphite of soda, and one drachm of citric acid, are dissolved in enough water to make up about nine ounces. To this there is then added one-half ounce of hydroquinone, and the whole is stirred till solution takes place, gentle heat being applied if any difficulty is met with.†

* Hydroquinone ... ... ·8 grain
Sulphite of soda ... ... 2·5 grains
Citric acid ... ... ·1 grain
Caustic potash ... ... 2·5 grains
Bromide of potassium ... ... ·1 grain
Water to make the solution up to ... ... 200 c.c.

† Hydroquinone ... ... 30 grains
Sulphite of soda ... ... 90 „
Citric acid ... ... 4 „
Water to make the solution up to ... ... 600 c.c.

This five per cent. solution must, of course, be used in just double the quantities recommended for the ten per cent. solution of pyro.

Eikonogen.—This developer is, when mixed with sulphite of soda, an extremely cleanly developer, with apparently no tendency at all to stain.

The substance is used in the same way as pyro, but two or three things must be closely observed. In the first place, it is necessary to use much more eikonogen than would be necessary in the case of pyro. In the second place, only carbonates can be used as alkalies, as caustic alkalies produce colour fog;* and, in the third place, if a restrainer is needed, it must not be bromide of ammonium, but either bromide of potassium or bromide of sodium.

Eikonogen is not soluble to the extent of ten per cent., but is soluble, though only with difficulty, to the extent of five per cent. A five per cent. solution of eikonogen can be made in precisely the same way as that recommended above for a five per cent. solution of hydroquinone, only that it is better to leave out the citric acid. The solution takes place much more quickly if the eikonogen be damped with glycerine before it is added to the water. I have now, since a little after the first introduction of eikonogen, kept what I use as a five per cent. solution of eikonogen, made up in the following way: A pound of eikonogen

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* This really applies only to caustic *ammonia*, and since the above was written caustic potash, or soda, has been recommended by Warnerke, and there is no doubt that, by replacing the alkaline carbonate with one-half or one-third the quantity of caustic alkali, the exposure may be reduced to one-half, perhaps, of that necessary with pyro-potash, in the case of such plates as will stand this very strong developer without either frilling or fogging, but I find that few will. In the case of this caustic alkali developer, as well as in that with hydroquinone, it is not so much more detail in the shadows that is got, but more *printable* detail.

was placed in a quart (40 oz.) stoppered bottle, which was filled up with a warm ten per cent. solution of sulphite of soda, and shaken. After using, the bottle has always been filled to the stopper with more sulphite of soda solution, and twice some of the solution has been poured away and a pound of the eikonogen has been added. This solution must be at least eight years old, and is still quite clear, but of a light green colour. In very cold weather it must be warmed and shaken, as, below about 65° F., the eikonogen crystallises out, and the solution is of a less strength than five per cent.

The work that I have done with eikonogen leads me to conclude that to equal pyro in effect it is necessary to use three times as much, and that, also, if large quantities of carbonate be used with it, a little bromide of potassium should be added even for normal exposure. The following developer has been found to give very satisfactory results:—

Five per cent. solution of eikonogen	120 minims
Ten per cent. solution of carbonate of soda (washing soda)	100 ,,

To each ounce of developer needed.*

The mixed developer will be found to be of a delicate green tint. It may be used for the development of several plates in succession. Eikonogen keeps badly in a bottle that has once been opened, and keeps only a few months in bottles that have not been opened. I have used this developer more in conjunction with pyro than alone. I have it at hand, and if a negative appears to be coming up hard, flow the soda-eikonogen over the surface, when soft detail rapidly comes up without much increase

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* Five per cent. solution of eikonogen ... ... 8 c.c.
Ten per cent. solution of carbonate of soda ... ... 6 c.c.
Water to make the solution up to ... ... 30 c.c.

of density. With plates that tend to give a hard image, the addition of about a dram of the five per cent. solution of eikonogen to each ounce of developer will overcome this tendency. Moreover, even this small addition greatly reduces the staining tendency of the pyro developer.

The Ferrous Oxalate Developer.—All the developers that have been as yet described have one character in common: they are all "alkaline" developers; that is to say, the solution has to be made distinctly—in some cases, strongly—alkaline to bring out its energy as a developer. It is true that eikonogen, as well as some of the newer developers, will work without the addition of an alkali, but the developer now to be described is totally different from any of the others, inasmuch as the first condition for successful working is that the solution be not alkaline, whilst it may, and even with advantage, be acid. The ferrous oxalate developer was a great favourite when gelatino-bromide dry plates were first introduced; but the NEW developers have put it a good deal in the background, although it has the advantage over pyro at least of cleanliness and simplicity, and gives an image of a very fine black.

The common way of mixing the developer is as follows:—A saturated solution of oxalate of potash is made. The oxalate of potash in the market is generally somewhat alkaline, and, as has been said, alkalinity is not permissible in the case of the oxalate developer. It is therefore necessary to neutralise this solution, or, still better, to render it distinctly acid. This may be done by preparing a strong solution of citric acid, and by adding this to the oxalate solution a little at a time, till blue litmus paper is turned red. No harm will be done if enough acid be added to turn the colour of blue litmus paper quite quickly. Acetic acid may be used, when the acidity of the solution can be told by the smell.

The other solution needed is a saturated solution* of ferrous sulphate, commonly known among photographers as proto-sulphate of iron. This salt is never alkaline.

A normal developer is made by mixing *about* three parts of the saturated solution of oxalate of potash with one of the ferrous sulphate solution. The latter should be poured into the former, not *vice versâ*. A beautiful red liquid results; that is the developer, to be used in precisely the same way as any of those already described. I have said that the proportions should be *about* three to four. The larger the proportion of iron, the quicker the developer; but there is a limit beyond which, if the ferrous solution is added, a precipitate is formed. This limit is reached when one part of the iron salt is used with about two of the oxalate. If, on the other hand, a smaller proportion of the iron salt is used, the development is slower; but, unless the quantity be very much reduced, as much, or nearly as much, detail will eventually be got out as with the more concentrated developer. Thus, many work with proportions of about six to one, and some prefer even to dilute such a solution with an equal part of water.

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* When saturated solutions are made in any large quantities, the best way of making them is to take an open jar sufficiently large to hold all the solution, to place in a muslin bag a little more of the salt than will dissolve in the water, and to suspend this a few inches below the upper edge of the jar by a piece of string tied to a stick or a glass rod laid across the top of the jar. The jar is then filled with water, and is set on one side for twenty-four hours or so. When only small quantities are to be made, it will probably be found most convenient to fill a bottle about half full with warm water, and to add the salt with constant shaking till no more will dissolve. In this case there will probably be some deposit at the bottom of the bottle on cooling, but that is of no consequence. The "Table of Solubilities" given at the end of the book will be found most useful as showing—at least approximately—how much of any of the salts commonly used in photography is necessary to make a saturated solution.

Bromide of potassium may be used to compensate for over-exposure just as with the pyro developer, but is not essential with normal exposure.

Several plates in succession may be developed in the same solution if no long time is allowed to elapse, but the liquid gradually absorbs oxygen from the air, and becomes exhausted.

A very concentrated oxalate developer may be made in the following manner:—A bottle is half filled with a saturated solution of oxalate of potash, and powdered ferrous sulphate is added, with much shaking, till no more will be taken up, or till there appears to be a deposit. An ounce of solution should take up about 80 to 100 grains of ferrous sulphate. Should there be a *thick*, orange-coloured, flocculent deposit, it shows that too much iron salt has been added, and enough oxalate of potash solution should be added to re-dissolve it. This concentrated solution is exceedingly energetic in its action—so energetic, in fact, as to make development almost beyond control, and to fog some kinds of plates even when they have not been acted on by light.

New Developers.

Only a few of these can be described here, for which fact it is to be hoped that the reader may be as thankful as the writer. One good quality all those described have: they do not stain if they be given fair treatment. The inveterate staining capacity of pyro is the one thing against it.

Metol.—This is a clean and very rapid developer. It is, in fact, so rapid that it is scarcely under control unless there is certainty that the exposure is not on the *over* side. Many claim that they can get more out of a plate with this developer than with any other, and there can be no doubt that it is good. There is sometimes a difficulty in getting density, and in any case the negative should be made apparently a good deal denser

than it is eventually intended to be, as it will lose much in the fixing bath.

A good two-solution developer is as follows :—

A.

Metol	60 grs.
Sulphite of soda	1 ounce
Water up to	10 ounces

B.

Carbonate of potassium ...	½ ounce
Bromide of potassium... ...	10 grs.
Water up to	10 ounces*

To use, mix in equal quantities.

In cases where there is no doubt that the exposure has not been "over"—as, for example, when the development of the first of a series of hand-camera exposures shows that it will be necessary to get all that we can out of the plates—a "one-solution" developer is very convenient. It may be made up as follows :

Metol	30 grains
Sulphite of soda	½ ounce
Potassium carbonate	2 drams
Potassium bromide	5 grains
Water up to	10 ounces†

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* A.—Metol ... ... 4 grams
Sulphite of soda ... ... 32 „
Water up to... ... ... 320 c.c.
B.—Carbonate of potassium ... ... 16 grams
Bromide of potassium ... ... ·7 gram
Water up to... ... ... 320 c.c.

† Metol ... ... 2 grams
Sulphite of soda ... ... 16 „
Potassium carbonate ... ... 8 „
Potassium bromide... ... ... ·7 gram
Water up to... ... ... 320 c.c.

For potassium carbonate, sodium carbonate (good quality washing soda) may be substituted, using double quantities in either case.

Additional carbonate or bromide have the same effect as with pyro.

Amidol.—This substance, which rejoices in the chemical name of diamido-phenol, is, as a developer, very similar to *metol* in its action, but that it is easier to get density with it than with the other. It is, indeed, not very easy at times to avoid hardness. It keeps scarcely as well in solution as metol. It will be seen that it works without alkali, except such as there may accidentally be in the sulphite of soda. Indeed, it is at its best when neutral. It will develop even when acid, but only slowly. It is a favourite developer for hand-camera exposures. The following formula will be found to give good results:—

Amidol	25 grains
Sulphite of soda	300 ,,
Bromide of potassium	5 ,,
Water up to	10 ounces*

Some prefer citric acid to a bromide for restraining. A drop or two of a saturated solution to each ounce is sufficient in most cases.

Mr. R. Neuhaus states that a very small quantity of clean hypo solution added to the amidol developer increases its activity, while at the same time reducing the tendency to fog; but that too large a quantity retards development.

Glycin.—This developer differs from the two just given in

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* Amidol	1·7 grams
Sulphite of soda	20 ,,
Bromide of potassium	·35 gram
Water up to...	32 c.c.

that it is much slower in its action, but that if time enough be given, it produces great density with very clear shadows, and that the density or opacity is less reduced during fixing than by most, or perhaps any other developers. It is essentially a developer to use when great contrast is wanted.

The following formula may be used:—

Glycin	80 grains
Sulphite of soda	200 ,,
Caustic potash	60 ,,
Water up to	10 ounces*

Rodinal.—This is a one-solution developer, having, I believe, paramidophenol as the active agent. Nothing is necessary but to mix a certain quantity of it with a certain quantity of water, when the developer is ready. With a fairly large quantity of the solution the action is very rapid, and a vigorous negative results. With less solution the action is slower, and the negative is softer. In my hands its action is very like that of hydroquinone with a caustic alkali. I consider it the best "ready-made" developer there is. It keeps well, and is cleanly in action.

A few names of other developers are:—Phenylhydrazine, hæmatoxylin, stannous salts, sodium hydrosulphite, vanadous oxalate, indigo white, chromous salts, catechol, diamide (hydraxine), anthion, dinol, ortol.†

Mixed Developers.—Nearly any two, or even three, of the developers described may be mixed. The mixture of pyro and

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* Glycin ... ... 5 grams
Sulphite of soda ... ... 13 ,,
Caustic potash ... ... 4 ,,
Water up to ... ... 320 c.c.

† Most of these names are taken from different volumes of *Photography* Annual.

eikonogen I have already mentioned, and a long series of experiments has persuaded me that there is often some advantage in mixed developers; but this is not the place in which to go into the subject fully. If, however, the student bears in mind that, though it is almost impossible to draw an exact line between them, all developers may be roughly classified as *density-giving* or *detail-giving* developers, he will see how it is possible to ring the changes on developers to suit different subjects and different plates.

There are many incompatibilities, however. For example, two developers described need to be neutral or acid; all others must be alkaline. There is no use of mixing either of the former with any of the latter. Then there are generally several alkalies that will work each with a certain developer, often one distinctly *best*. This may be an alkali incompatible with other developers, and the first-mentioned must not be mixed with any of these. Finally, ferrous oxalate mixed with pyro makes common black writing ink.

Ready-made Developers.—Very many makers sell these. As a rule they are in the form of one solution, only needing dilution with water. The makers seldom state their ingredients or their proportions, so that one using them is working a good deal in the dark. Moreover, it is never possible to have as much control over the final result as when two or more solutions are used. Still, these developers are very convenient, and, moreover, all—and that means far from few—that I have tried have given very good results when the exposure was just that to suit the plate and the developer. I believe, moreover, that every ready-made developer is amenable to treatment with bromide. I consider that bromide of potassium is the safest to use.

CHAPTER XIII.

DEFECTS AND REMEDIES.

The photographer will certainly not practise the gelatine dry-plate process very long before he comes across some of the defects that are peculiar to it. I intend, therefore, to describe these as accurately as I can, and, where possible, to give a means of either preventing the occurrence of the objectionable phenomenon, or of curing it when it has made its appearance. When the error is of a kind due to the *preparation* of the plates, I shall not enter into the cause of it, but merely indicate the cure in cases when such is possible.

General fog.—This is probably the commonest of all faults in gelatine negatives. It consists of a veil over the whole plate, showing itself by want of transparency in the shadows. It may be so slight as to be imperceptible, except when the negative is laid face downwards on a sheet of white paper, and, in fact, almost always exists to this extent in gelatine negatives; or may be so dense as to make the time necessary to get a print be measured by days. It is due to one of two causes, which are usually indicated by the terms *chemical fog* and *light fog*.

The first is inherent to the plate, being due to error in its preparation, or to its ageing, for plates do not keep for ever. In

such a climate as that of England they should keep for at least two or three years. As a general rule, rapid plates do not keep as well as slow, and plates keep worse in a hot—especially a hot *and* damp—climate than in a temperate one. By it is meant that the sensitive film is in such a condition that the silver salt is reduced by the developer without light having acted upon it. I know of no remedy for such a state of affairs.

The best way to distinguish chemical fog from light fog is to develop an unexposed plate, performing all the operations in total darkness. This is not difficult. If the plate is found to have darkened, the fog is chemical fog, or, what is practically the same thing to the photographer, light fog brought about by the action of light on the emulsion whilst in the hands of the manufacturer.

With well-restrained developers, chemical fog is less likely to make its appearance than with strong developers. Indeed, if plates show only a slight tendency towards chemical fog, the fault may be entirely overcome by somewhat increasing the exposure, say by 50 per cent., and by adding enough bromide of potassium or of ammonium to the developer to counteract this moderate over-exposure.

Light fog is due to the action of light in one of three ways: first, on account of an unsafe light in the dark-room; secondly, on account of a defect in the camera or dark slide admitting light; and thirdly, on account of over-exposure.

When the fog is due to light in the camera, this will be recognized by the fact that the portions of the plates covered by the wires or rebates of the dark slides remain free from fog. When this is the case, the camera must be carefully examined by removing the focussing screen, and looking for the smallest defect which might admit light, the camera being placed in direct sunshine, and the head of the observer being covered

with the focussing cloth. Light finding its way through defects in the slides generally shows itself in the form of streaks or lines. Should no defect be detected, it may be assumed that over-exposure is the cause of the fog, and a shorter may be tried.

If fog from unsafe light in the dark-room be suspected, a plate is placed in the dark slide, one of the shutters is drawn half-way, and the slide is laid for five minutes on the table where the plates are changed and developed. The plate is then developed, and if one-half darkens, it shows that the light is not safe, and steps must be taken to render it so.

Green fog.—This defect is always due to error in the manufacture of the plates. It generally makes its appearance only in the shadows of the negative. If the negative be looked at by reflected light, a black object being laid under it, the shadows will be seen to be bright green. On looking through the negative they may appear somewhat pink, or sometimes a sort of "muddy" colour. Green fog makes its appearance only with alkaline development, or, in the case of ferrous oxalate, only when the chemicals are impure, and chiefly when the plate has been under-exposed, and development has been "forced"; even with the alkaline developer it seldom makes its appearance except when a caustic alkali (as ammonia) is used.

A slight amount of green fog is not detrimental to the printing qualities of a negative; but if the defect show itself in an aggravated form, the best means of preventing it is to resort to ferrous-oxalate development. Captain Abney gave a means of curing plates afflicted with green fog after development, full particulars of which appeared in the *Photographic News* for April 28th, 1882. It consists in bleaching the negative with a solution of ferric bromide, oxalate, or chloride, and afterwards applying the ferrous-oxalate developer.

Red fog seems to be an aggravated form of the last-mentioned disease. It appears as a deep red deposit, showing itself by transmitted light in the shadows of the negative. It is rarely met with at the present time, although it was common in the early days of gelatine plates. It does not make its appearance in plates developed with ferrous oxalate. Probably Captain Abney's cure for green fog would correct this defect also.*

Frilling consists in an expansion of the film to such an extent that it loses its adhesion to the glass and "frills" off. The phenomenon begins at the edge of the plate, and spreads towards the centre. When the expansion begins at the centre it is termed blistering. It is due to an error in the manufacture of the plate, but is much aggravated by a developer strong in alkali, by the use of warm solutions, by the use of too strong a fixing bath, or by the use of very soft water for washing. When it makes its appearance only in the fixing bath or during washing, it may be prevented almost with certainty by placing the plate, immediately after development, in a saturated solution of alum for five minutes. This I advise in all cases; but where there is no fear of frilling, the plate should be thoroughly rinsed before it is placed in the alum solution.

In an extreme case, where ordinary alum is found not to be effectual, chrome alum, which is more energetic in its action, may be used.

If the frilling be of so aggravated a form as to show itself during development, it is more difficult to prevent its occurrence; but this may be done by placing the plate, before development,

* It would be better to class the above two kinds of fog as "colour fog." The two colours mentioned are certainly the commonest, but I think I have seen, especially when experimenting with eikonogen, every colour of the rainbow well represented. Abney's method can barely be said to be a *cure* for colour fog. It is simply a means of converting it to *grey* fog (chemical fog), in which form it is generally comparatively harmless.

in weak *formaline*, which is an article of commerce—a solution (said to be of a strength of 4 per cent.) of *formaldehyde*. A mixture of 3 or 4 per cent. of the commercial product will do, and five minutes is time enough. This effectually tans the gelatine of the film. The treatment with formaline should be followed by a washing. Some recommend that the formaline be mixed with the developer, but I cannot recommend such a mixture, as I have found fog to result from it. The best preventive that I know is that suggested by Mr. W. B. Bolton, namely, to use a saturated solution of common salt, instead of plain water, in making up the developer. If the oxalate developer be used, the plates may be placed in an alum bath *before* development. This is a certain cure, but is not permissible in the case of alkaline development. Frilling may often be prevented by running a piece of wax or solid paraffin (a paraffin candle, for instance) round the edge of the plate before it goes into the developer.

Plates that frill when newly prepared, in many cases show no tendency to the defect after keeping for some weeks or months in a dry place. In fact, I have found that the keeping of gelatine plates for some time often improves them in many ways.

Want of density or flatness of image is usually due to under-development, or to the use of too weak a developer, and very often to over-exposure combined with one of these. A consideration of the remarks in the last chapter on development will show how sufficient density may be gained in almost any case; and I may here say that, when the ammonia developer is used, a very common cause of want of vigour is to be found in the fact that the ammonia is not so strong as is supposed, and that the development is not protracted for the time which would be necessary to get density with a developer weak in ammonia. A very short exposure to the air weakens liquid ammonia of

·880 specific gravity, because ammonia gas escapes. It will be generally found that the last of the ammonia in a bottle is considerably below the standard strength, simply from the escape of the gas every time the bottle is opened. It is for this reason that the dilution of the ammonia with an equal bulk of water, immediately after purchasing it, was recommended. Merely pouring the strongest ammonia from one bottle to another will perceptibly weaken it.

There are some plates that will not give a vigorous negative, however they be developed. This is the case with plates on which the emulsion has been too thinly spread. If such plates are to be used at all, an after-process of intensification must be resorted to. It will occasionally happen, too, with the best of plates, that an error of judgment is made in development, and that the process is stopped before density is sufficient. This is another case for intensification. I shall treat of intensification in a separate chapter.

Too great density of image is a fault sometimes met with. It is always due to error of judgment in development. It may be corrected by going through the first part of the process for intensification, afterwards described. This method is objectionable, however, as the results may not be permanent.

A much better method is the following. A solution of hyposulphite of soda of the strength used for fixing negatives is made up. A saturated solution of ferricyanide of potassium—red prussiate of potash, not ferricyanide *yellow* prussiate—is also mixed. The negative to be reduced is soaked in the hypo solution till the film is soft—the assumption is that the need for reduction has not been discovered till the negative has been dried. It is then removed from the dish, into which is poured a few drops of the red prussiate of potash solution. The negative is placed into the mixed solutions, when a perceptible reduction of density will very rapidly take place. If the action cease before the

negative is thin enough, a few more drops of the red prussiate solution are added. Great care must be taken not to let the action go too far. If the defect be observed immediately after fixing, the operation of reducing density should be set about at once, as at this stage it will proceed with much greater quickness and less chance of irregularity than at any other. The plate is removed from the hypo bath, and, without washing, is placed in a dish of water to which a few drops of the saturated solution of ferricyanide of potassium have been added.

Spots of various kinds are liable to be found in the finished negative. They are of various forms, and are produced in various ways.

Minute transparent spots or pinholes are caused by dust resting on the plate during exposure. The plate should be brushed with a broad camel's hair brush, or a tuft of fine cotton wool, before it is placed in the slide.

Small transparent spots with irregular outlines are due to defect in the manufacture of the plate, and cannot be corrected by after-manipulation other than that of the retoucher's pencil.

Small, transparent, perfectly circular spots, with well-defined outlines, are due to air-bubbles in the developer, and are seldom produced, except when too small a quantity of developer is used.

Opaque spots are almost always due to defects in the plates, and cannot be corrected by after-manipulation. They may occasionally arise from foreign matter in the developer.

A yellow stain over the whole of a negative is often found after pyrogallic development, especially if ammonia has been used. Plates vary greatly in their liability to this defect. With most it will not occur if the instructions with regard to the use of the alum bath after development be carefully followed; but, if it do, it may be removed by placing the negative, after fixing and washing, in the following:—

Saturated solution of alum	...	...	10 ounces
Hydrochloric acid	...	...	½ ounce*

This defect has become much less common since the general introduction of the use of sulphite of soda in the alkaline developer.

A yellow fog occasionally occurs, and must not be confused with the stain described. It is, in fact, a variety of the colour fogs of which the green and red are the commonest, and is to be treated as such. It is to be distinguished from the stain by the fact that it is yellow only by reflected light, whilst the stain is yellow only by transmitted light.

Unequal thickness of film is sometimes found in commercial plates.† It arises from careless coating of the glass, and is, of course, incurable by after-treatment. The negative resulting from a plate more thinly coated at one place than at another may be lacking in density at the thin place; but it should be borne in mind that it need not certainly be so. Plates are generally coated with films considerably thicker than is absolutely necessary, and, in the case of a plate unequally coated, the thinnest part may contain enough of the silver salt to give the necessary density. Plates should, therefore, be tried before being condemned for unequal coating.

Various *streaks*, *scratches*, *&c.*, occur in gelatine plates, and are evidently due to defects in manufacture, or more often to careless treatment by the photographer afterwards. They call for no particular remark.

A white, powdery deposit is sometimes found on the surface of the negative after drying, especially in the case of ferrous-oxalate development. It is in such a case caused by lime in

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* Hydrochloric acid... ... ... 50 c.c.
Saturated solution of alum ... ... 1 litre

† Very rarely at the present time.

the washing water. It may be removed by dipping the negative in a 1 per cent. solution of hydrochloric acid. If the solution of alum used before fixing be acid, and the negative be not sufficiently washed between the alum and the fixing bath, a deposit of sulphur may form on the film in a fine powder. This can be removed by gently rubbing the face of a negative with a plug of cotton-wool while water is running on it from the tap.

Irregular action of the developer, causing zig-zag lines across the plate, may occur if the developer has not been made to flow over the plate in one wave at first.

Halation is caused chiefly by reflection of light from the back of the plate. It makes itself evident only when the subject includes very strong contrasts: for example, when an interior with windows open to the sky is photographed, it shows itself in the form of a halo round the highest lights, and produces a very unpleasant effect, sometimes known as blurring. It shows less in the case of plates that are thickly coated than in the case of those that have thin films. It shows with films much less than with plates. With ordinary plates it shows less with a thick than with a thin film; but there are now non-halation plates which are strongly to be recommended. Those of the genuine make have coatings of emulsion of different sensitiveness, that next the glass being very slow and *red* by transmitted light, that on the surface being rapid, and there being, in plates for very trying cases, an intermediate film of moderate rapidity.

In the case of an attempt being made to photograph a very trying subject, such as the interior mentioned, with an ordinary plate, it is well to back the same; that is, to paint or otherwise cover it at the back with some substance that will absorb light. The following is a good method to adopt. Procure a piece of black carbon tissue, cut out a piece slightly smaller than the size of the plate to be used (there should be about one-eighth of

an inch margin all round), moisten the tissue with water, allow it to become as nearly dry as is compatible with its remaining quite limp, then again moisten the black surface, but this time with glycerine; allow all that will to drain off, and press the tissue against the back of the glass. It will adhere, and may be removed just before development.

Solarisation, or reversal of the image, is a curious phonomenon which may be brought about in any gelatine plate. It consists in a reversed action of light—or, rather, a reversed action of the developer, produced by excessive action of light. It is found that if light, beyond a certain amount, be allowed to act on a sensitive film, *less* instead of greater density occurs after development by the increase. This peculiar action does not, as a rule, give rise to practical inconvenience; but if, for example, the sun be included in a photograph, it will usually be found to be represented by a *transparent* spot on the negative, and consequently by a black spot in the print. Tendency to reversal is much greater in some plates than in others. It is reduced by the use of bromide in the developer.

The Ravages of Insects.—In England the common cockroach will sometimes eat into the film of a drying negative, destroying it. In the tropics the trouble of insects of many kinds is really serious, because it becomes quite a difficult matter to dry a negative without adopting special means. I have found a cure in soaking the plate in a 2 or 3 per cent. solution of formaline after washing, then merely rinsing in water, so that some formaline remains in the film. I have not yet been troubled by any insect that appeared to relish formic aldehyde.

CHAPTER XIV.

INTENSIFICATION OF THE NEGATIVE.—VARNISHING.

Towards the end of the last chapter I described the conditions that give rise to the occasional necessity for intensifying a negative. The term almost explains itself. It means the increasing of the density. A good intensifier will increase the density of every part of a negative proportionately; that is to say, when there is, after fixing, clear glass in the shadows, no darkening will take place there; but every grade of density, from the finest detail to the densest high-light, will be increased in a proportionate degree. The process ought to be thoroughly at the command of the operator, who should be able to produce any desired increase of density.

I may say at once that in my opinion there is no thoroughly satisfactory intensifier for gelatine negatives, and that such a thing is a great desideratum. It does not fall within the province of this little work to enter into a discussion as to which is the best of the various more or less imperfect methods that have from time to time been published; but I shall give a formula which has, at any rate, the advantage of simplicity, and which will be found to give fairly good results. It is one of the "mercury" intensifiers. It has two drawbacks: first, the results are not always permanent; second, there is great difficulty in regulating the amount of intensification given by it.

The first objection is much lessened, however, from the fact

—not, I believe, generally known—that when a mercury intensified negative fades, it can generally be brought back to its original condition by performing again the process of intensification. Let us suppose that a negative, on printing, is found to give a poor-looking print, lacking contrast. The following solution is prepared:—

Bichloride of mercury	1 ounce
Water	10 ounces

The whole of the bichloride of mercury will not dissolve, but the residue may be left in the bottle, and as the solution gets low through unavoidable waste, water may be added.

The negative is very thoroughly washed. It is placed in a dish, and the mercury solution is poured over it. It will gradually become whitened or bleached. When the film is bleached throughout—as indicated by its being white at the back—the solution is poured back into the bottle, and the negative is again most thoroughly washed. On the thoroughness of this washing seems to depend to a great degree the permanency of the results, and it also prevents a yellow staining of the negative, which is fatal to good results.

The negative has now to be treated with ammonia solution, which will blacken it; but the strength of the ammonia solution must be varied according to the amount of density needed. Thus, if the print got from the negative previous to treating with mercury was nearly up to the mark, a very weak solution of ammonia must be used: one or two drops to the ounce of water will be enough. This solution is poured over the negative, which will be seen gradually to darken. When all action ceases, the process is complete. The negative will now be of a brownish tinge by transmitted light. If, on the other hand, the negative was one giving a very shadowy print, a mixture of ammonia and water in the proportion of one to twenty may be used. On this being poured over the plate, darkening will take

place almost instantly, and the result will be a fine, black-coloured negative. If necessary, the whole process may be repeated over and over again, but the additional density gained by each repetition of the process will be less and less.

Since the last few paragraphs were written, a modification of the mercury developer has been introduced. In this a solution of sulphite of soda replaces the ammonia, with the result, it is said, of a more permanent negative. This is, of course, an advantage, and another is, that a far less thorough washing after bleaching suffices—indeed, a good rinse is all that is necessary. The precise strength of the sulphite solution is not of great consequence: a ten per cent. solution may be used. It is not, as far as my experience goes, possible to intensify to nearly so great an extent with the sulphite as with ammonia, for which reason, when the negative is *very* weak, the latter should be used. Should the intensification, either by ammonia or sulphite of soda, turn out to be too great, the plate, after washing, may be placed in the hypo bath. This will remove a portion of the intensity given by intensification.*

It is advisable to take a trial print from every negative before varnishing; and, in fact, if ready-sensitised paper, or any other kind which is always quite dry, be used, varnishing is not absolutely necessary at all. It is very advisable, however, and I shall describe the process before entering on the subject of printing.

After the negative is thoroughly washed and quite dry, it is taken by the left hand by that corner which, were it a printed page, would be called the left-hand bottom corner. It is warmed gently over a gas-burner till it is just warm enough to feel pleasant to the touch. If a gas burner fixed above the level of the operator's head be used, a good criterion of the proper temperature is

* There are now many other intensifiers, but I do not like any of them so well as the two here given.

gained by watching the moisture which condenses on the plate from the water formed by the combustion of the gas. When the moisture at first condensed is dispersed, and no more will condense on a plate, it is just at the right temperature. In hot climates the heat of the sun is quite sufficient. The plate is now held level, by the corner mentioned, between the finger and thumb, whilst the varnish bottle is held in the right hand. A large pool of varnish is gently poured on to the centre of the plate. This pool should cover about half of the area of the glass. The plate is gently "tipped," so as to cause the varnish to flow first to one corner and then to another, beginning at that opposite to the one by which it is held. When the varnish comes round to the bottom right-hand corner, the plate is tipped slowly up to a vertical position, so that all the excess of varnish may flow back into the bottle. The plate must be rocked from side to side during this part of the process, to prevent the formation of crapey lines. When all varnish that will flow off of its own accord has flowed off, it will be seen that there is still a "thick edge" —or, more generally, two, namely, the bottom one and the right hand one. A small piece of blotting-paper is taken between the first finger and the thumb of the right hand, and is rapidly run along these edges to remove this excess, and then the plate must be again warmed—this time till it is about as hot as the hand can bear. When it is cold it is ready to be printed from. There is a vast difference between plates as to the ease with which the varnish will flow over them. The process is one that should in no case be performed over a choice carpet.

Even with the greatest care some varnish is nearly sure to get on the back of the plate. This can readily be removed by rubbing with spirits of wine or methylated spirits, especially if the glass be heated a little.

CHAPTER XV.

NEGATIVES ON FLEXIBLE SUPPORTS.

In the first negative process that was invented—that entitled the Talbotype, from its originator, Fox Talbot—the sensitive film was supported on paper. It was not till Archer invented the collodion process in 1850 that glass was generally used as a support for the film. The great advantage that the collodion process offered over any that had gone before caused it to be adopted in spite of the one drawback—the weight and breakability of the glass. From that time to this, however, it may be said that the glass has been used only under protest. It has always been felt that at some time paper, or some such light and flexible substance, would take its place, and that this should be used in continuous rolls. Even the introduction of a means of using paper in continuous lengths is by no means a new thing. If I am not mistaken, a roller slide for exposing sensitive paper—such as was used in the Talbotype process—is a thing of nearly forty years ago.

For several years paper ingeniously prepared so that it might be made transparent by oiling, or that the film might be stripped from it and be transferred to a transparent flexible gelatine support, held its own, and many good results were got; but one process was messy, the other delicate and tedious. Since then *celluloid films* have so nearly approached perfection that it seems

scarcely necessary to describe any other flexible supports, though hardened gelatine is used, and though, whilst celluloid films *approach* perfection, they have not quite got there yet.

The advantages of films over glass may be summed up in a few words.

Films are very much lighter than glass, both as regards carriage in bulk, and in the slide or slides; and the finished negatives are both lighter and easier to store. They are not liable to breakage.

By the use of a magazine or the roller slide, it is possible to make exposures, one after another, at a rate quite impossible with glass plates.

Halation does not make its appearance with paper or films to nearly the same extent as with glass.

The negatives can be printed from either side. This is a great advantage in many cases. The advantage in the case of cloud negatives will readily be understood by those who have practised the printing-in of clouds, whilst that in the case of the carbon process will be understood by all those who know the difference between single and double transfers. There is also a great advantage in the case of those photo-mechanical processes that need a reversed negative.

The process of development is much easier than where glass is used. It is, in fact, quite possible to develop a dozen films at the same time, using a very slow developer.

The roll-holder, of which we illustrate the pioneer amongst modern apparatus, consists of an appliance which slides into the groove of the camera made for the ordinary dark-slide. When the roll-holder is placed in position, a portion of a continuous roll of sensitive film is brought into the plane occupied by the ground glass while the image was being focussed. Between this film and the lens there intervenes nothing but a shutter similar to that used with an ordinary dark-slide. In fact, the

film on its support simply replaces the film on glass, but with this very great difference, that when it is necessary to replace one film with another, instead of having to reverse the slide or take up another one, we have only to turn a key till a certain

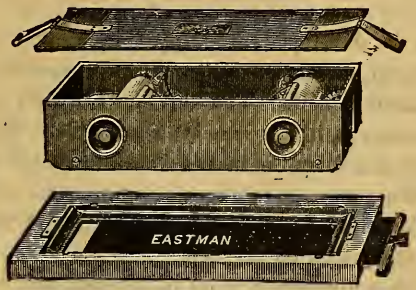


Fig. 1.

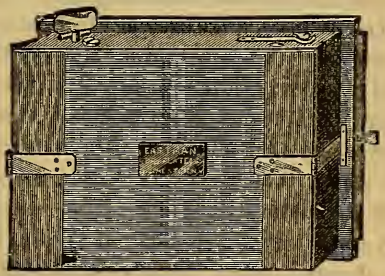


Fig. 2.

indication is given, when, by the winding of the exposed film on to one roller, we have a fresh film in position. This process can be repeated till all the films are exposed. The film is afterwards unwound from the spool (which latter is removable), is cut up into lengths by marks which guiding rollers produce in revolving, and is developed. A second roll may then be placed in the slide. The film is sent out ready wound on spools to fit the apparatus.

I cannot give space to describe the appliance in detail, but the two cuts shown on the preceding page will give a very fair idea of the pioneer apparatus referred to. The first shows it open for the removal or reception of a spool. The second shows it ready for use.*

Films to be developed are dipped in clean water for a few minutes till all inclination to curl nearly ceases. After that, they are placed in a dish, and developed exactly as glass plates are. Of course, as in the case of a glass plate, the formula for development given by the maker of a film should be used.

Several films may be developed in the same dish if this be somewhat larger in size than they. The lowest film is continually lifted and placed on the top.

If there be a number of films to develop, and there be doubt as to the correctness of the exposure, it is well to use two separate dishes of developer, No. 1 filled with a very much restrained developer, No. 2 with a normal solution. The films are all placed into No. 1, after soaking in water. Those which show an image in this bath before very long, proving that they have been over-exposed, are allowed to remain in it till they are finished, whilst those that do not show for several minutes, or only show the highest lights then, are transferred to No. 2. If here they come up too rapidly, and show a tendency to veil over in the shadows before density in the lights is sufficient, they may still be returned to No. 1. If they come up just as they should, showing that exposure has been right, of course they need no further development; whilst if they are under-exposed, as much can probably be got out of them by letting them remain for a long time in No. 2, as by any amount of forcing by the addition of more alkali.

* Great advances in the construction of apparatus have been made by Kodak, Limited (successors to Eastman Co.), at 43, Clerkenwell Road, London.

If the film has become foggy, but not hopelessly so, ferrous oxalate or hydrokinone, with an alkaline carbonate, gives the best chance of a fair result.

Alum and fixing baths, as well as washing, are as with plates.

Rolled films need to be secured at the corners during drying, to prevent them curling up.

In all cases, instructions with regard to matters of detail are issued with the films, and should have due attention.

To print from a film negative, it is placed on a plate of clear glass in the printing frame, when the process proceeds as usual.

Of celluloid films there are two kinds, namely, *cut* films, and *rolled* films. I do not know the details of manufacture of either of these, but I believe that the cut films are just what they are called—films cut with a sharp instrument from a solid block of celluloid, being, indeed, "shavings" of celluloid. The rolled films, on the other hand, are produced by squeezing celluloid in a more or less plastic or undried condition between rolls.

I am, perhaps, not fairly positioned to speak of the merits of films, but am certainly fairly placed to judge of their defects, for all my film work—and it is not a little—has been done in countries where new films could not be got, where it was impossible to find out even how old the old films were, bad films were "dumped," and where development had to be performed with the thermometer often over 90° F. in the dark-room.

I state without hesitation that films, taken all round, do not keep as well as plates, and that rolled films keep worse than cut films. There seems to be some reaction between the celluloid and the bromide of silver, which produces general fog.

On cut films I have certainly got as good results as on glass, but the percentage of really good negatives has been smaller. With rolled films I can scarcely say that I have *ever* got as good results as with glass, simple blackness being the result of ninety

per cent. of the work. I have, however, by sending special instructions to forward *perfectly new* rolled films from England to Japan got results so good, that it would need an expert to find fault with them, or to avow that they were not from glass. Then there is the delightful convenience and lightness of the roll-holder and its spool, all ready for several dozen exposures, or even, perhaps, a round hundred.

The pessimistic part of the foregoing applies fitly to such exiles as myself. I believe that work of the highest quality can be done on films by those who are near a source of supply; but I most earnestly warn all against trusting them—at any rate, rolled films—for "Round the World" trips, and the like. I once developed one hundred exposed films for a "globe trotter;" on ninety-nine there was blackness only, on the one hundredth an oblique line running from bottom corner to top corner, which proved to be the horizon with sea below, and sky—without a cloud—above.

Rolled films are much thinner than cut, and give some trouble in development and drying by their tendency to curl up into squills. This difficulty is, however, easily got over by a little practice.

CHAPTER XVI.

PRINTING AND TONING WITH ALBUMENISED PAPER.

The photographer who has followed these instructions to the present point will so far have produced only means to an end; the end itself will be nowhere visible. He has made the materials for a picture, but the picture has still to be constructed from these materials. However delightful a negative may be to the photographer as containing infinite possibilities, it is to the common eye by no means a thing of beauty. Every shade is, as has been explained, reversed; before a natural effect can be produced these shades must be re-reversed, so as to represent those of nature. This is commonly done by resorting to the process of printing. This process consists in placing in contact with the negative a sensitive film usually supported on paper, and allowing light to act on it through the negative—the effect being, as a little consideration will show, a reversal of all shades.

There are many printing processes, all of which may be studied with advantage by the amateur. Each one has certain advantages, and some are especially suited for certain purposes; but the process that, for a wonderfully long time, held its own against all others, was that called "silver printing on albumenised paper." Times out of number it has been said that this process

was doomed, yet it has survived, although it is far from being either the best process or the most popular. The best are those which give permanent results on matt, or even rough surfaces, giving an image either *black*, or of some colour very different from the "photographic brown" and "photographic purple" that used to be so dear to the heart of the photographer, but that have never appealed very much to the eye of those who have any real artistic taste. The most popular paper at the present time is one called "printing-out paper," for which three words the makers and vendors generally use a vile abbreviation. The various brands of this paper are coated with gelatine or collodion emulsions, the sensitive salt being in whole or part chloride of silver. These papers can be had to give either a "glossy" or a "matt" surface. They are not difficult to work, and undoubtedly give pleasing results. Moreover, they keep well, at least several times as long as sensitised albumenised paper.

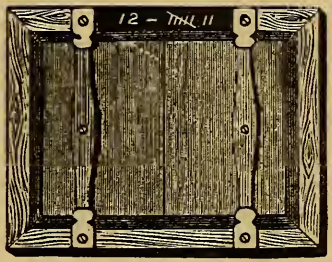
In spite of all, however, sensitised albumenised paper is still much used, and, as it is the case that one who has mastered the working of it can work any good printing-out paper,* I still keep here a great part of what was written a good many years ago, but I leave out of the question the idea that the amateur will sensitise his own paper.

"Ready-sensitised" albumenised paper is an article of commerce, and its convenience is so great that its adoption is to be recommended to the beginner. I shall therefore here describe the manipulation of such paper.

In printing with any kind of printing-out paper a printing frame is used. This apparatus is of various forms, but all have the same object. They keep the paper in close contact with the negative, and are so constructed that one-half of the print can be

* Sensitised albumenised paper is strictly a "printing-out paper," but the latter term has come to be confined to emulsion-coated papers that print out; that is to say, that do not need development.

examined at any time, whilst the other is kept in contact with the negative to prevent it from slipping. In frames made at the present day, the necessary pressure on the backs is gained by the use of springs. For small negatives, the frame is usually made exactly to fit the plate. In the case of large negatives — above whole-plate, for example — the frame is generally made somewhat larger than the negative for which it is intended, and is fitted with plate-glass, against which the

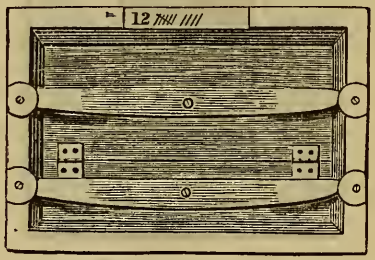


negative is placed. The pressure of the springs would be liable to break a large negative were it not thus protected. In the case of large negatives it is also necessary to use a pad of felt between the paper and the back of the frame, to ensure contact. Two of the commonest forms of printing frames are here illustrated. A neat "dodge" is shown at the side of the frame for registering the number of prints taken from any negative.

Let us suppose that our beginner has purchased a printing-frame and a certain amount of ready-sensitised paper. He cuts the paper to about the size of the negative he has determined to print from. He places a piece of the paper under the negative in the frame, and lays the whole outside in a bright diffused light. It is not generally advisable to print in direct sunlight. After the operation has gone on for a short time—say, five or ten minutes—the result may be ascertained by

taking the frame into a weak light and examining the print, one-half at a time. It must be allowed to print considerably darker than it is finally to be. The exact amount of depth that is lost in the after-processes can only be learned by experience, but I may roughly say that it is necessary to print for nearly twice as long a time as that needed to give a pleasing result in the frame.

It is at this stage of proceedings that we for the first time become certain whether our negative is all that can be wished,



or whether it may be improved by either reducing or increasing the density. It is necessary, to give a good result, in the case of most subjects, that the darkest part of the print should be about as dark as the paper is capable of becoming. It is also necessary that the negative should have such density that, while this takes place, the high-lights of the print may remain almost or quite white. If there be not such density, either one of two things must occur: either we must stop printing before the shadows are deep enough, and, as a consequence, there is no boldness of effect; or we must allow those parts that ought to remain white to get dark. The consequence is, in either case, lack of contrast. The cure is intensification of the negative.

On the other hand, we may find that we have too great density, and that, in consequence, not only the deepest shadows, but some of what ought to be only half-tone, turn as dark as

the paper is capable of becoming before the detail in the lighter parts becomes evident. It sometimes occurs in such a case, also, that the very dark parts assume a peculiar appearance known as "bronzing." In the case of an over-dense negative, one of two things occurs: we have large masses of shadow printed so dark that all detail is lost, or we have large masses of light in which detail has not made its appearance. The remedy is reduction of density.

Sometimes, however, we find that we have a state of things not quite so bad as we have described, but that a negative shows indications of being a very little too dense or too thin. In this case it is a pity to resort to either intensification or reduction of density, as these processes are neither of them very completely under control. We may proceed as follows:—

We clean thoroughly the back of the negative, and varnish it *cold*. After a time the varnish will set with a "matt" surface; that is, with a surface like ground glass. We now take it, and if the density be too great, we scrape away the varnish from the *densest parts*, using a penknife; if the density be too little, we scrape it away from the *transparent* parts. This will make a sensible difference in the resulting print; but if it still lack something, we may mark on the matt varnish with a soft pencil, in the case of too great density shading over the transparent portions, in the case of too little over the densest parts.

Another plan is to stretch a piece of tissue paper on the back of the negative, fixing it with glue at the edges only. This may then be worked on either with the stump or the pencil, the density being supplemented where needed. A negative "dodged" in either of these ways described may never be printed in direct sunshine.

It is to be noted that even without intensifying or dodging

in any way, a slight amount of compensation for too great or too slight density may be gained simply by selecting a suitable light for printing in. Thus, if a negative be slightly too dense, a better result will be gained by printing in very bright sunlight than in the shade. If, on the other hand, it be slightly too thin, the best result is obtained by printing in a feeble light. The extent to which over and under density can in this manner be compensated for is but slight. I believe that the difference of result to be gained by printing in light more or less bright has been greatly exaggerated by most who have written on the subject.

When the desired number of proofs has been printed, the paper should be trimmed to the right size. This is generally done, in the cases of small sizes, with scissors, using "cutting moulds," or thick plates of glass, that can be had of any size. It is often the custom to trim large prints, as well as small, by the aid of cutting moulds, but I think the plan is a mistake. It is very seldom that a print is not improved by cutting away a little foreground, a little sky, or a little of one side, and to be able to do this makes it impossible to keep to the precise size of any mould. Of course these remarks apply, strictly speaking, to small as well as to large prints, but the advantage of liberal trimming is far more conspicuous in the case of large than of small work. Moreover, two small sizes, the "carte" and the "cabinet," have got so firmly established, that if a print be anywhere near the size of one of them, it is considered well to trim it to the precise size.

In trimming large prints, I advise that the limits of the print be marked with pencil by the aid of a T-square and a drawing-board, the operator not hesitating to lop off considerable parts of his print if he think that a better picture will result thereby. The actual cutting may be done either with a sharp knife or a pair of scissors.

One thing to observe in trimming prints is, that the edges must be made parallel to and perpendicular to any vertical line in the subject—for example, the corner of a building—or to the horizon, if it be a sea horizon.

Many prefer to trim their prints after they have gone through the various processes of toning, fixing, and washing; but there are several advantages in trimming before toning. The clippings, if kept, become, when a large quantity has accumulated, of value, on account of the silver in them; there is a saving of toning solutions, and the trimming is far easier before washing than after, as the paper lies flat, whereas afterwards it is liable to curl up in a way that makes it difficult to manipulate. The following solution is mixed for toning:—

Chloride of gold	... 15 grains
Acetate of soda	... 1 ounce
Water	... up to 15 ounces

The chloride of gold is bought in small sealed tubes holding fifteen or thirty grains each. One of these tubes is placed in a bottle capable of holding the whole solution; when there, it is broken by striking it with a glass rod, due care being taken not to break the bottle, a thing that is quite possible. The acetate of soda is then added, and the water being poured in, the whole is shaken till the acetate dissolves. The solution must be kept at least twenty-four hours before use, and not be exposed to a strong light. It should be labelled "*Toning Solution, One Grain to the Ounce.*" The other solution which is needed is one of two ounces of hyposulphite of soda to each pint of water, with enough ammonia added to make the solution smell slightly of it, and should be labelled "*Fixing Solution for Prints.*"

It will be noticed that the prints, as they come from the frames, are generally of a more or less unpleasant colour. The

operation to be described, and which is called toning, is intended to correct this defect, and to give the prints the pleasing colour we are accustomed to see. The process consists in covering the image with an exceedingly thin film of gold, or rather, in substituting gold for a certain portion of the silver or silver salt of the image.

Toning may be said to be at once the easiest and the most difficult of photographic processes. Nothing is easier than to *tone*, nothing more difficult than to tone *well*. Anyone can change the colour of a print to a sort of slatey grey; there are not very many who can be sure of getting at all times a pleasing tone and the exact tint wanted. The difficulty lies in the direction so common in photographic operations. A certain result is gained, but the after-processes modify this result, so that great experience is necessary to know beforehand what will be the final appearance of the subject.

I shall describe as accurately as possible the operations, and for the rest, as in so many cases, the beginner must look to intelligence and practice for complete success.

The toning solution mentioned above is too concentrated to be used as it is; it must, therefore, be diluted. The common practice is to use a large quantity of toning solution, and, if it is not exhausted, to keep it for after-use. This is very well for the professional photographer, who tones at regular intervals, but in the case of the amateur I think it is scarcely advisable. The solution once used is very liable to "go bad," the gold being deposited at the bottom of the bottle. I therefore recommend that the beginner estimate the quantity of toning solution that will be necessary, allowing a little margin, and that, after he has used it once, he throw it away. The waste will be very small—so small that it will not be found worth while to keep the liquid as residue. If the prints be trimmed before toning, one grain of chloride of gold

is generally enough for each sheet of paper measuring 17 by 22. One ounce of the stock toning solution is therefore taken for every sheet of paper, and is to be diluted with ten or fourteen times its amount of water.

Different samples of paper need toning baths of different strengths. As a rule, the best results will be got when it needs about a quarter of an hour to tone to a purple, eight to ten minutes to a chocolate colour. If more time than this is needed, the bath should be made stronger; if less, weaker. Some samples of "double albumenised paper" need a bath as strong as one grain of gold chloride to five ounces of water; but an attempt should always be made first with a bath of the strength mentioned in the last paragraph.

The prints are now taken, one by one, and placed face downwards in any dish that is suitable for washing them in; a common small wooden tub is, perhaps, the best of all. They must be kept from sticking to each other, and be moved about by hand. It will be seen that the water becomes milky, from the nitrate of silver in the paper forming chloride and carbonate of silver with the salts in the washing water. At this point there should be a divergence in the operations, according to the tone that the photographer wants.

If a photographer wish a brown, his proceedings should be as follows:—The prints are very thoroughly washed. To effect this, the water must be frequently changed. When all milkiness has disappeared, the prints are laid for a few minutes in a bath containing one ounce of common salt to a gallon of water. They are then washed again with several changes of water.

If a purple tone be wished, the prints are washed for only a few minutes. If they be in a large vessel, it is enough to turn them over once—that is to say, to remove the bottom print to the top till all have been so treated, and to run off the

water. They are now placed for five minutes in a bath containing one ounce of washing soda to the gallon of water, when they receive a final moderate washing. The use of the soda is to neutralise the acid that usually exists in ready-sensitised paper, and that greatly retards toning. It (the soda) will, however, accelerate toning, even when no acid has been used in the preparation of the paper.

After either of the operations just described is finished, the prints are ready for toning. The washing is best done by the light of a candle or lamp, as such will not affect the paper. The toning must be done in feeble white light, as it is difficult to judge of colours by yellow light. It is best performed in a flat white dish at least an inch longer each way than the prints.

One print is taken from the washing water and placed in the toning, first face downwards; it is then turned face up, then again down, repeating the process once or twice, so as to allow the solution to act evenly on it. Now another print, and perhaps two or three more, are similarly placed in the solution. It will be noticed that the prints, during washing, turn to a brick red. In the toning they will turn to a brown, and gradually—at any rate, if treated with soda, as described—to a sort of violet or purple. They must be kept in constant motion. The best plan is to keep continually lifting the undermost print, and placing it on the top. At first, only a few prints should be attempted together; after some practice, a dozen or two may be in the solution at once. When many prints are toned together, it is a good plan to have two dishes of toning solution side by side, and to keep lifting the prints out of one into the other, the whole of the prints being turned over in a mass when they are all in one dish.

The colour will be noticed gradually to change. In the case of the prints which have been thoroughly washed and treated

with salt, the change will be comparatively slow; it will probably, with no amount of pushing, result in a colour deeper than a brown. In this case, however, the colour attained may be relied on to change but slightly during fixing, &c.; whereas, in the case of the soda-treated prints, a certain amount of the tone will often be lost. For this reason it is necessary to go a little farther than appears at the time necessary. When it is judged that a print is toned, it is placed in a dish of clear water. It is moved about for a few seconds to get rid of the greater part of the toning solution that is in the pores of the paper, and that would make the toning proceed after it is wished to stop it. When all the prints have passed through the toning bath, they must be washed in several changes of water, being kept moving for about five minutes during each change.

Fixing.—The prints are taken from the washing water, and placed in a flat dish. Sufficient fixing solution to quite cover the prints is poured in, and they are kept moving for about twenty minutes. The tone, especially when it is pretty deep, may be seen to fall off considerably when the prints are first placed in the fixing solution. It will, however, in a great measure return during washing and drying. After fixing, it is necessary to wash the prints most thoroughly. This is best done in running water, but if such cannot be had, then frequent changes will do. It is common to recommend washing for not less than twelve hours, but it should be borne in mind that, if the washing be so done that each print is continually brought into contact with clean water, the process will be more perfect in one hour than if the prints be merely allowed to stick together in a mass with water running on them. There are several machines made for facilitating washing, on the principle of keeping the prints in continual motion in running water. Most of these finish the process in an hour or so. The smallest trace of hyposulphite left in the prints may cause them to fade.

The thing most necessary to observe during all these operations is, that the prints be at no time allowed to stick together in a mass. If this occur at any stage, a disagreeable colour, with yellow or degraded whites, is sure to result. It is also necessary to observe that the prints be kept throughout all these processes back upwards, otherwise a fine powder may be deposited on the face of them.

CHAPTER XVII.

VARIOUS OTHER SILVER PRINTING PROCESSES.

Printing on Plain Paper—On Gelatino-Citro-Chloride Paper—On Collodio-Chloride—On "Rapid" Paper—On Gelatino-Bromide Paper.

Printing on Plain Paper.

The tendency at the present day is certainly, for the most part, in the direction of printing processes that give a "matt" instead of a glazed surface, and the oldest of photographic printing processes, that of printing on plain paper, has come in for a share of favour.

At the present time there are various brands of "printing-out" plain papers in the market. Most of them are emulsion papers, and should be worked in accordance with instructions sent out with them. Some are not, but are "sensitised" papers of the kind to be immediately described, but that they will generally keep for at least a month or two.

The papers that are described are generally very smooth, although without actual glaze; but I think that far the most artistic result is got by printing on actually rough drawing paper, such as Whatman's, at any rate in cases where the size of the work is considerable—say 10 by 8, or over. Very beautiful results may also be got by printing on various other surfaces,

such as thin Japanese paper, linen, white silk, &c. The process that I now describe gives magnificent results on thick, rough drawing paper, and very good results on almost any surface that I have tried, and that is, from its appearance, suitable to receive a picture.* The only trouble about working the process is, that all the operations must be completed within a day in hot weather, within two or three days at the most in any kind of weather. The results, however, compare, I think, favourably with those obtained by any other process.

The "salting" solution is made up as follows:—

Gelatine	100 grains
Chloride of ammonium	30 ,,
Water	8 ounces
Negative varnish	2 ,, †

The solution is to be mixed in the following way:—The gelatine—any gelatine of good quality will do—is soaked in the water till it is soft, when it is melted by placing the containing vessel in boiling water. The chloride of ammonium is next added, and lastly the negative varnish is poured in a thin stream, with constant stirring, into the mixture. A white emulsion is the result.

To "salt" paper, a sheet is laid on a drawing-board or plate of clean glass sloping a little towards the operator, and the solution,

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* This process was introduced to Japan by the writer, and it may interest readers to know the last application of it. It has been applied to producing a picture on that end of the "obi," or broad silk sash worn by ladies, that hangs down at the back. I am by no means certain that this application is justifiable on artistic grounds.

† Gelatine ... ... 6 gr.
Chloride of ammonium .. .. 2 ,,
Water ... ... 200 c.c.
Negative varnish .. .. 50 ,,

still warm, is applied with a soft sponge or a ball of cotton-wool. It is applied in broad, parallel sweeps across the board, beginning at the upper edge, the paper once coated being turned through a right angle, and the process being repeated, so that the sweeps cross each other.

The surface to be salted should be marked with a pencil mark in one corner—or, perhaps, it were better to mark the back. It is not of consequence so long as the same practice is adhered to in all cases before it is salted. It is hung up to dry by American clips, and will keep in this state indefinitely, light having no effect on it.

The sensitising solution is made up as follows:—

Silver nitrate	1 ounce
Water up to	8 ounces*

To this solution there is added slowly strong ammonia till the dark precipitate formed at first is re-dissolved, leaving a clear solution. One-half of this is then taken, and nitric acid is added until it is neutral, or very slightly acid, as indicated by test papers. The two halves are once again mixed, the solution is filtered, and is then ready for use.

Sensitising is done in precisely the same way as salting, the side that has received the salt being thoroughly damped with the sensitising solution. If the paper be thick, like drawing-paper, the process should be repeated twice. The paper is sensitised once, is lain on one side for ten minutes, or long enough to let it get surface-dry, and is then sensitised a second time, and is hung up by American clips in a warm place to dry. The sensitising is best done by gas or lamp light. The paper is ready to be printed on whenever it is dry. Printing, toning, and fixing are done in exactly the same way as for albumenised

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* Silver nitrate ... ... 30 gr.
Water enough to make the solution up to ... ... 240 c.c.

paper, but that the following points of detail must be attended to. The printing should be carried a *little* farther in the frames than in the case of albumenised paper, as there is a little more loss of depth during the after-processes. It will be found that the toning proceeds with greater ease than in the case of albumenised paper, and that any colour to a very deep purple—nearly a black—can readily be got; indeed, the toning is so quick that care must be taken that it does not get beyond control. The toning solution may generally, with advantage, be somewhat more dilute than for albumenised paper, and need never approach the strength sometimes necessary to tone highly-glazed double albumenised papers.

Gelatino-Citro-Chloride Paper.

Recently, paper coated with an emulsion of chloride of silver together with some organic salt of silver in gelatine has come pretty widely into use in place of albumenised paper, and is sold as "printing-out paper," with surface either glazed or matt. It has certain decided advantages. Thus it keeps considerably better than the best "ready-sensitised" paper that I know of, though it does discolour in time, and after that it is not advisable to use it; yet in a pinch it may be, as it clears in a wonderful way in the fixing bath; it prints more quickly by some two or three times; it gives a very vigorous image, so that, whilst it is not well suited for printing from very strong negatives, it gives excellent results from the ordinary run of negatives, and is particularly useful for printing from such as are too thin, giving results with which prints on bath-sensitised paper are not to be compared; and lastly, there are several reasons—into which I cannot go here—for believing that the results are more permanent than those on albumenised paper.

The paper is printed in the ordinary way, allowance for

reduction of intensity by after-processes being made, just as for albumenised paper. With the paper are always issued instructions for toning, but the following may be taken as a typical formula:—

Chloride of gold	3 grains
Sulphocyanide of ammonium ...	100 ,,
Hyposulphite of soda	5 ,,
Water...	10 ounces*

The chloride of gold is mixed in one-half of the water, the other two salts in the other, and just before toning begins the former is poured into the latter, a red precipitate being at first formed, which is quickly re-dissolved.

The gelatino-chloride paper takes up more gold in toning than does albumenised paper. The quantity given above will probably serve to tone only a sheet and a half of paper. It may, however, be used for two sheets, and, as the toning operation flags, a little more gold chloride may be added.

The prints are washed for about five minutes before they go into the toning solution. When there, they will probably turn first of all to a very sickly colour, but will eventually become brown, then purple. The toning must be carried much farther than appears necessary judging by surface colours only. It is best to judge by transmitted light, bearing in mind that the eventual surface tone will be a little deeper than the colour seen by transmitted light, and therefore toning till the prints appear quite over-toned by reflected light, a little under-toned by transmitted light.

The prints may go directly from the toning to the fixing

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* Chloride of gold ... ... ·25 gr.
Sulphocyanide of ammonium... ... ... 8 ,,
Hyposulphite of soda ... ... ·4 ,,
Water ... ... 400 c.c.

bath, where they remain for ten minutes, when they are washed for half an hour or so in continually changing water, after which they are treated for five minutes in a five per cent. solution of common alum, and are again washed.

Care must be taken not to allow a warm finger to remain for any length of time in contact with the film at any one place, at any rate before the alum bath is reached, otherwise the film will be melted, and a spot will be the result.

A brilliant effect is got by drying such prints in contact with glass. Clean plates of glass are prepared by rubbing them with a piece of flannel that has been dipped in a solution of a few grains of beeswax in an ounce of benzine, then polishing them with French chalk, removing as much of this material as possible with a dry cloth, and squeegeeing the prints down on them. When dry, they strip from the glass with a high polish. If it be wished to mount such prints, a sheet of very thin pasteboard is glued to the back of each whilst it is still damp on the glass, and all is allowed to dry together.

Collodio-Chloride Printing.

This process corresponds very closely with the last described. Indeed, it is almost precisely the same, except that collodion forms the medium for holding the sensitive salts instead of gelatine. The collodion process is of much older date than the gelatine, and has for long been practised by a few, but it is only on account of the recent introduction of the ready-made paper on a large commercial scale that the process has become at all popular.

There is very little to say in favour of one process as against the other, except that, with the collodion process, there is not the danger that there always is with the gelatine process in very hot weather, that the film will melt off in the toning bath; and, further, no alum bath is necessary, and of course that

amounts to a saving of trouble. On the other hand, some collodion papers, at any rate, have a most irritating way of curling up almost to squills in water and solutions.

The working of the collodio-chloride is practically the same as that of the gelatino-citro-chloride just described, but that the alum bath is not needed. Full instructions are, however, always issued with the paper, and should be attended to.

Rapid Printing Papers.

The end of the year 1884 saw a great stir in the photographic world, on account of the announcement that a new printing paper was to be brought out that would need an exposure many hundred times less than albumenised paper needs, and that would yet give warm-toned prints.

It was easy to see, from the appearance of the paper, that it was coated with a gelatine emulsion, and it soon became an open secret that the haloids used were chloride, bromide, or a mixture of chloride and bromide of silver.

The method of working the paper is briefly as follows :—

An exposure is made in a printing-frame in the ordinary way, except that only a second or two is given in the case of diffused light, or in the case of an ordinary gas-light, with a distance between the light and the flame of eight or ten inches, anything from a minute or so to half an hour, according to the density of the negative and the effect wished.

The image is not visible if exposure has been correct, unless the negative is one with very strong contrasts. In such a case there may be some slight trace of an image in the deepest shadows. The absence of a visible image, of course, makes the timing of the exposure a thing needing some judgment. There is, however, fortunately, considerable latitude allowable.

The paper is developed when it is taken from the frames. The developer may be either very weak and much restrained

ferrous oxalate, ferro citro-oxalate, or hydroquinone. With the papers there are, of course, sent out full instructions for mixing the developing solutions, and so forth.

The development of the print is an operation needing considerable judgment. The image must be closely watched, and the print must be removed from the bath almost before it has got as dark as it will be finally needed. If the exposure has been right, the colour of the print at this stage will be a dullish red. If the exposure has been too short, it will be a greenish-black; if too long, the image will be flat and lacking in vigour. Several prints may be developed at one time, but not very many. Whenever the print is taken from the developer it must be washed in several changes of water. After this it is immersed for a quarter of an hour in a saturated solution of alum. It is then washed again, when it is ready for toning. The same formula which is recommended for albumenised paper may be used, but its action is slow with the rapid paper. If, however, it be made of double the strength mentioned on p. 153, and there be added to each pint of it four grains of chloride of lime, the toning will go on rapidly enough. The toning needs to be continued till the surface of the print is quite purple, and if any but a very warm brown tone be required, for some time longer. The time to stop toning is best judged by looking through the print at a light.

After the prints are toned, they are washed and fixed in the ordinary manner. It will be noticed that the tone almost entirely vanishes in the fixing bath. It returns to a great extent on drying.

Mr. Warnerke recommends that toning and fixing be done in the same bath by adding a little chloride of gold to the hyposulphite solution. A considerable saving of time is effected by this way of working. The prints are washed after fixing just as albumenised prints are. They may be mounted in the

usual manner, and rolled or burnished if wished. A very brilliant effect is produced by drying them in optical contact with glass, as already described for printing-out gelatine paper.

Gelatino-Bromide Printing.

This process is, perhaps, more used for enlarging than for anything else; but it is certainly also used to a great extent for direct printing. Paper is coated with gelatino-bromide emulsion that differs in no essential from that used for coating plates, but that it is generally much slower. A short exposure to artificial light is given in a printing-frame, and the print is then developed in the same way as a plate.

The prints got by the process are of an engraving black, somewhat resembling platinotypes. Indeed, it is a curious thing that, when platinotype was in its earlier days, the great fault that was found with it was that the prints did not look like ordinary photographs. A recent boast of gelatino-bromide printing is, that it gives results that cannot be distinguished from platinotype.

The sensitive side of the paper may always be recognised by the fact that the edges curl in a little towards it. It is impossible to give any precise instructions as to time of exposure, as different brands of paper vary greatly in sensitiveness, and the exposure will vary greatly with the negative; but it may be said that ten seconds at one foot from an ordinary gas burner will represent the exposure with paper of average sensitiveness, and with a negative of average density.

Development may be done either with ferrous oxalate, with hydroquinone, eikonogen, or nearly any of the new developers. Ferrous oxalate, made distinctly acid with citric or some other acid, and somewhat diluted, is generally preferred. The carbonate of soda or carbonate of potash hydroquinone developer (mentioned Chapter XII.) may be used. Eikonogen is a very useful

developer when either paper or negative, or both, incline to give a harsh result with ferrous oxalate or hydroquinone. The slower papers incline to give harsh or hard prints from all but thin negatives with these latter developers, and of course a hard negative inclines to a hard print. With eikonogen the tendency is much less. The developer given for negatives, diluted with an equal quantity of water, may be used.

Whatever developer is used, the paper is first soaked in clean water till it is limp, and is then laid on the bottom of a developing dish, when the developer is poured over it. The action must be watched very closely, and the developer must be poured off immediately that the print appears dark enough, as there is no loss of strength during after-processes. The print is lightly rinsed in water, and then is placed in a two per cent. solution of citric or acetic acid. It remains there for five minutes or so, and is then thoroughly washed, and is fixed in a *clean* ten per cent. solution of hyposulphite of soda. It is just possible to see the process of fixing by looking through the paper, but it is not easy; and, moreover, it is advisable to leave the print in the hypo solution for much longer than the minute or so that is necessary to effect fixing. Ten minutes will be enough; but, if there are several prints in the bath at the same time, care must be taken that the solution has free access to all of them.

The prints, after fixing, have only to be thoroughly washed and to be dried—operations that may be conducted in daylight.

It will be found that, as a rule, the best results will be got on gelatino-bromide paper from negatives that are rather too thin for ordinary silver printing.

CHAPTER XVIII.

DEFECTS IN SILVER PRINTS, AND REMEDIES.

The following are the defects most commonly met with in any of the various kinds of silver prints. I give the remedy in every case where I know of one:—

The Prints are Yellow in the Whites—or, to speak more strictly, in the parts that ought to be white.

I leave out of consideration the case where the paper has been kept too long before printing, or between printing and toning, and has turned brown, for, of course, in such a case it is unreasonable to expect pure whites, although the fixing baths will very considerably reduce the discolouration.

Yellowness appearing in the whites of the prints after the manipulations of washing, &c., have begun, may be due to any one of several causes. If the prints be allowed to stick together in masses in the first washing water, yellowness will be the result. The action of too much white light on the print at any stage before the fixing will have the same effect. So will any of a great number of foreign substances—notably hypo—in the toning bath, or in the washing waters used before toning. Lastly, acidity of the fixing bath may produce the yellowness. It is, as has already been stated, advisable to add to the fixing bath, for silver prints, as much ammonia as will cause it to smell slightly of the alkali. The remedy in the other cases is evident.

In the case of gelatine or collodion emulsion papers, which are themselves acid, the toning bath must be particularly well looked after.

Insufficient fixing of any kind of silver paper is the commonest cause of yellowing in any time, from a few days to a number of years.

Fading, in the sense of weakening—*some*times nearly the actual disappearance—of the image is due to insufficient washing after fixing.

Mealiness is scarcely ever met with, except in the case of albumenised paper. It is a term that should be used only to denote a peculiar mottled appearance of the surface of a print, but that is often used to describe any lack of brilliancy evidently not due to lack of contrast in the negative. The true mealiness is caused by weakness of the silver bath. It is generally accompanied by *lack of contrast* due to the same cause, and often to *loss of brilliancy of the surface of the print.* The fault generally lies in the paper, though foreign matter in the toning bath may be responsible for it.

Marble-like markings on the paper are now seldom met with. They are due to fault in the paper.

Refusal of the Print to Tone.—The print will refuse to tone, or will tone only slowly to an unsatisfactory colour, if the sensitising bath be acid, or if it be much contaminated with organic matter. The acidity may be prevented by adding carbonate of soda as suggested. Organic matter is got rid of by frequent sunning.

Some papers are much more difficult to tone than others. The remedy, if toning is intolerably long, is to increase the strength of the toning bath, especially in gold. It should also be borne in mind that, if a toning bath be used over and over again, the gold is liable to be spontaneously thrown down from the bath. In this case it will be seen in the form of a

fine black precipitate clinging to the sides and bottom of the bottle.

If the toning bath be acid, it will not tone in a satisfactory manner. Its condition may be ascertained with test paper, and if it be found to be acid, it may be made neutral or slightly alkaline with bicarbonate of soda.

A Loss of Tone in the Fixing Bath sometimes occurs when the prints have not been sufficiently washed before the toning operations.

Unevenness of Tone almost always has its origin in the sticking together of the prints in the toning bath, but sometimes from their being allowed to stick together in the washing waters used before toning, whereby they are unequally washed. The remedy, of course, is to prevent them from sticking together in the washing water or the toning bath.

Bronzing is an appearance which is seen only in the shadows of prints got from negatives showing very bold contrasts. It is seen on looking at a print from a certain angle. The appearance is that of a metallic lustre in the deepest shadows. It is but seldom that it does not disappear in the fixing bath.

Metallic Spots sometimes make their appearance on the paper before it is put into the printing frame. They are dark, of metallic lustre, of size from that of a pin's head upwards, with irregular outline. They are almost always due to particles of iron in the paper itself, and are, of course, beyond the control of the photographer; but they are sometimes due to particles of iron in the blotting-paper or blotting-boards between which many photographers partially dry their paper after sensitising.

CHAPTER XIX.

MOUNTING PRINTS—VIGNETTING—PRINTING OF SKIES INTO NEGATIVES.

Mounting the Prints.

Of many ways of mounting, the following is, perhaps, as good as any other:—

A thin paste of corn starch is made up as for culinary purposes; that is to say, a comparatively thick paste is made up with cold water, then *boiling* water is added with much stirring till the mixture is nearly liquid. A fraction of a grain of thymol may be added to each ounce to prevent any chance of souring.

The prints are laid in a heap on a clean sheet or plate of glass, and the upper one is quickly covered with a thin layer of the mountant, using a soft broad brush. It is not necessary to keep strictly within the limits of the top print, as all are in for their dose of the mountant. The print is then taken up by two opposite corners, and is gently placed in position. A clean cloth is applied to the face of the print, and is gently, but firmly, rubbed with the hand, or a squeegee—a strip of india-rubber with a wooden handle—is used.

If, as is customary with carte and cabinet prints, they are mounted with a narrow margin, the adjustment of the paper on the mount may be done by eye but if, as is customary with large prints, especially landscapes, a wide margin is adopted,

the position of two opposite corners of the print should be marked on it with a needle point.

Mounted prints on glossy paper should either be rolled or burnished. Rolling consists in passing the prints between two polished metal rollers, or a polished roller and plate. The roller or roller plate may, or may not, be heated. Burnishing consists in *drawing* the print over a bar of polished steel that is always heated, the print being first treated with a solution of four or five grains of Castile soap in an ounce of methylated spirit rubbed on to the surface of it with a piece of flannel, and being allowed to dry. A far higher polish is given by the burnisher than by a rolling press; indeed, the polish given by the burnisher is by many considered to be offensive. It is not usual to burnish prints much larger than cabinet size. If the amateur do not possess either a burnisher or a rolling press, he can usually get his prints burnished or rolled by sending them to some neighbouring photographer.

If it be wished to keep prints on some kinds of paper unmounted, it is somewhat difficult to keep them from curling up as they dry. This applies particularly to prints on albumenised paper, and I have found the following to be a convenient manner of drying such and treating them afterwards.

The prints, as they are taken from the washing water, are allowed to drain for a few seconds, then blotted off with clean white blotting-paper, and laid to dry, *face downwards*, on a table covered with a clean cloth or with clean white blotting-paper. When they have lain till they are dry to the touch, one of them is rolled tightly on a wooden roller, albumenised side outwards. The end of a second print is caught under that of the first, which is nearly rolled up, and so the rolling goes on, each print being caused to catch up another just before this first is completely rolled up. The roll of prints is laid aside for a few days, after which they will show very little inclination

to roll up *face inwards*, as they otherwise would. They may be further improved by hot rolling with a plate and roller machine.

Vignetting.

The effect produced by what is known as vignetting is one that is admired by many, especially when it is applied to a suitable picture. It is so easy to do it that the amateur should be instructed in the method.

Innumerable "dodges" have been invented for producing the vignette effect; some have been patented, some have been sold as secret processes; but, after all, the simplest way of all seems to give as good results as any other. An opening is made in a piece of cardboard or other stiff material. This opening is made of the shape that the image is to be, but a little smaller, and the cardboard is fixed in front of the printing-frame whilst printing goes on in diffused light, or, better still, with a piece of tissue paper over the opening cut in the cardboard.

The softness of the vignette depends on the distance between the negative and the cardboard. The greater the distance, the broader the portions through which there is shading off.

With most printing-frames it is sufficient to fix the cardboard —with drawing pins or otherwise—to the front of the frame. It is my practice, if this arrangement does not give sufficient softness of shading, to pinch the edges of the opening upwards with my finger and thumb.*

It is often necessary to modify the vignetting board by cutting out bits here and there, or by cutting new boards entirely, a trial print being made after each modification before the most satisfactory results can be got.

The negative that lends itself best to the production of vignettes is one full of detail, and giving a somewhat soft print.

* Mr. Lyonel Clark has recommended thin sheet lead for making vignettes. It will be found very convenient, as the edges of the opening can so easily be pinched up.

Printing Skies into Landscapes.

A white sky in a photographic print is, almost without exception, from an artistic point of view, an abomination. Few beginners would believe the change that can be wrought by printing a bit of cloud into a sky otherwise quite white. A picture is often *made* by this simple means.

The printing of clouds into skies is by no means difficult. The first requisite is, of course, a selection of cloud negatives. These are easily enough made. Exposures are given on suitable looking clouds, the lengths of time given in the tables under the heading "Sea and Sky," or something a little shorter, being suitable in most cases.

The clouds, to be useful, must be well chosen. The most brilliant-looking clouds are almost always such as are near the sun; but although these are often so beautiful that they will make pictures in themselves, they are comparatively little use for the purpose of printing into landscapes, for it is seldom that landscapes are taken looking towards the sun, and it is essential that the clouds printed into a landscape should be lighted from the same point that the landscape is.

A series of cloud negatives, then, of all kinds that have any beauty in them, and lighted in all different ways, but especially from the side, should be made. As already mentioned, those taken on paper or films have the immense advantage that they can be printed from either side, thus virtually being each equal to two negatives, one lighted from each side.

Now as to the printing of such clouds into the landscapes. It is almost essential that the skies should be quite white in the first place. If they be not naturally dense enough in the negative, they must be *masked* by colouring the sky in the negative with some opaque colour, great care being taken in following the horizon line.

I shall take first of all the case of a landscape with a horizon pretty nearly straight, as this is the simplest. It is convenient to use a printing frame considerably larger than the negative, so that there is room to make adjustment between it and the print.

The print—with sky white—is placed on the negative that has been selected as most suitable, and is so adjusted that the clouds fall into the position that seems best. The back of the printing frame is now adjusted, and the focussing cloth is loosely thrown across one side of the frame, so as to cover the landscape part of the photograph. Printing is done in the shade, and the focussing cloth is slightly shifted from time to time, so that the sky, white or nearly so at the horizon, gradually darkens a little higher up, the clouds showing. When the sky is printed as dark as is just necessary, the print is finished. As a rule, none but those who have very considerable artistic taste and knowledge, and much practice, should risk printing-in skies other than very light—no more, in fact, than to give an indication of clouds.

If dark objects project into the sky they may be disregarded; the clouds printed across them will not show.

If, however, light objects project into the sky it is necessary to mask them, so as to protect them from the light passing through the cloud negative. The best way to do this is to take a print from the landscape negative. This, untoned and unfixed, is cut with a pair of scissors or a sharp pen-knife, so as to follow the line of demarcation between landscape and sky, care being taken to cut a shade *within* the landscape—that is to say, to cut a trifle off the landscape. This mask is now fixed with two wafers at its lower corners on to the cloud negative, so as to cover all but what is to be printed into the landscape. The print has now to be very carefully adjusted over this, when all is ready for exposure.

Even when the horizon is straight, if it is wished to bring the clouds quite down to it, masking must be resorted to.

A simply "graduated" sky—very much better than a blank white one, as good as anything for some subjects—is made by exposing the upper or sky part of the print to light, whilst a sheet of cardboard is held over the landscape part, and is kept in motion so as to *graduate* the darkening.

Cloud negatives can be bought from most dealers, but many will have conscientious scruples about using them, and afterwards exhibiting the prints as their own productions.

CHAPTER XX.

THE PLATINOTYPE PROCESS.

I HAVE said that silver printing will probably still be largely used by many. It is, however, now hard run by several processes, and perhaps by none so hard as by that known as the platinotype. This, although of but comparatively recent date as a commercial printing process, has nevertheless become a great favourite, and appears to be ever gaining in the estimation of the public. Indeed, it may be said that, in England at any rate, it is now the process most worked of any by those who aspire to artistic results. This is certainly not without reason, for it is in many respects the most attractive of all printing processes. It has several very great advantages over the silver process. Firstly, and chiefly, the results are permanent; secondly, they are, to an artistic eye, far more pleasing than those of silver printing—except, perhaps, that on rough paper the colour is an engraving black, and the surface is not glazed, but matt, like drawing paper; thirdly, the process is far more easy to work. The time taken for printing is not quite half what is necessary for albumenised paper. There is no toning, nor is there any prolonged washing.

There are, at present, several somewhat different platinotype processes worked in England. The two that are most popular are both the invention of Mr. W. Willis. The paper and

other materials can be had from any of many dealers, who always issue therewith instructions of the most precise nature. A description much shorter than the importance of the process would justify must suffice here.

The Hot Bath Process.

The paper for this process is coated with a mixture of a salt of iron and a salt of platinum. The one thing that requires great and constant attention is to keep this paper thoroughly dry. It has to be kept in a metal case with a small quantity of calcium chloride, when not actually in the frames, and when in these, it is necessary to keep a thin sheet of india-rubber behind it.

Printing is done in the usual way, but the image that appears is not brown, or purple, but a faint greyish-yellow colour. This at first is puzzling, but one soon learns to judge of the exposure as accurately as with silver. The prints have to be developed by floating them on the surface of a hot solution, containing 130 grains of oxalate of potash to each ounce of water. A flat iron dish is the best to operate with. The solution is kept at a temperature of 170° to 180° Fahr., by means of a spirit lamp or Bunsen burner. The process of development is a most beautiful one. The print, before it is developed, is only just visible. It is placed thus on the surface of the solution, and in a few seconds there is removed a picture perfect in colour and gradation of tone. It is possible to compensate for a considerable amount of over-exposure by using the developing solution cooler than is mentioned above.

The developed print is transferred to a dish containing one part of hydrochloric acid in sixty parts of water. Hence it passes to a second, and then to a third similar bath, remaining a few minutes in each.

It is then washed for about a quarter of an hour in several

changes of water, after which it is finished. Negatives which are just somewhat dense for silver printing give the best results with platinum. Any negative, however, which will give a good silver print will give a good platinum print.

The Platinotype Company have introduced a paper which gives a warmer colour than the one of which we have been writing. The tint got on it is somewhat of the nature of a sepia brown.

The Cold Bath Process.

This is another outcome of the genius of Mr. Willis. In the process just described there is some trouble in having to be so exceedingly careful about the dryness of the paper, and in having to use hot solutions. The trouble is not, certainly, serious, but there is the farther fact that, with a given negative, there is but little latitude in the effect producible, and that, moreover, the negatives needed for the process are, on the whole, a little denser than those that do best for common silver printing. With the "cold bath" process there are none of these difficulties. The paper contains an iron salt only, and the *developer* contains the platinum that is necessary to form the image. The paper, if stored for any length of time, has to be kept in calcium tubes, but no particular care is necessary to prevent slight dampness in the printing frames. In fact, some trace of dampness, such as paper will absorb from the atmosphere in a few minutes, or in very dry weather in an hour or two, is necessary to get the best results, and it is on account of the fact that the effect is different according to the length of time that the paper remains out of the calcium tube before development. Thus, if the print be quickly made, and be developed at once, the contrast will be great, the half-tone but slight, and this is what is wanted in printing from a thin negative. If, on the other hand, the print be put on one side for a few hours after printing, there will be less contrast and

more half-tone, and thus it will be possible to get a harmonious result from an over-dense negative. Farther variation in result is producible by variation in the mixing of the developing solution.

As in the case of the "hot bath" process, the Platinotype Company issue such full instructions with the paper that there is no need to do more than give the barest outline of a description of the manipulations.

The paper has about the same appearance, and is printed in the same way, as the hot bath process, but that no rubber sheets have to be used in the printing frames. The developing solution, as already indicated, contains the platinum, and is used cold.

The image is, I think, a little brighter, and therefore more easily judged of in the printing frame, than in the case of the hot bath process. As has been indicated above, the prints are developed at once, or after they have lain loose in a drawer or box for any time up to three or four hours, according to the nature of the negatives that they are made from, or the nature of prints that are wished. They are then floated, one at a time, on the developing solution. A print is allowed to float for a few seconds, and is then removed and held in the hand. It will be observed that the darkening is much slower than in the case of the hot bath, and that it proceeds to a certain extent whilst the print is held in the hand. It may, however, be necessary to float for two or three times to get sufficient depth. I have found it possible with this process to get bright prints from negatives so thin that they would scarcely give tolerable prints on albumenised paper. In any case, the process must be watched closely, and the moment that the right result is got, the picture must go into the first of three baths of dilute hydrochloric acid made up as for the hot bath process.

It says well for the keeping qualities of this paper that I have had it sent from the Platinotype Company, of London, to

Japan, and that it has arrived, after a journey of more than two months, in perfect condition.

Pizzighelli's Printing-Out Platinotype Process.

This process is now several years old. It is the invention of one who has done an immense deal in the matter of investigating various platinum processes. The title indicates what is the distinguishing feature of the process, namely, that the image comes fully out in the printing frame. This effect is brought about by having in the film with which the paper is coated both the printing and the developing chemicals used by Willis in his hot bath process.

My experience of this process is extremely small, being limited to such experiments as I could make with a few pieces of the paper sent by mail by Mr. George Davison. The following can, however, be stated with confidence. The paper prints much more slowly than that of Willis, but, the image being fully visible in the frames, there is little chance of any misjudgment of exposure. It would seem that it is necessary to allow the paper to absorb a little moisture before printing, so that the reduction of the platinum may take place.

After the print has become deep enough, nothing is necessary but to pass it directly to the hydrochloric acid bath. Printing is thus, by this process, reduced to about the greatest degree of simplicity and certainty that is possible.

I may say that the few little bits of paper that I mention as having been sent to me by Mr. Davison were wrapped only in a piece of yellow paper, but that they arrived in Japan from England in perfect condition.

The Platinum Process of Messrs. Valentine Blanchard and Lyonel Clark.

These might have been, perhaps, described in a former chapter as modified silver printing processes rather than as platinum

processes, because Mr. Clark's process is certainly a process of printing in silver and afterwards *toning* with platinum, and Mr. Blanchard's process is of the same nature; but as, in the announcements and descriptions of both processes, more emphasis has been laid on the platinum than on the silver, I insert them here.

Mr. Blanchard's process has given good results in my hands, the image being of a rich black tint; but I do not know if the paper is now to be had in the market.

The following is a short description of Mr. Clark's process. Prints are made in silver on any kind of plain paper that is suitable for photography. The process described in the beginning of the last chapter will be found suitable. These prints are made fully as dark as for ordinary gold toning.

The following solution is now to be made up:—

Chloro-platinite of potassium*	... 60 grains
Nitric acid	about 30 to 40 minims
Water	... 32 ounces†

The prints are to be washed *thoroughly* to remove the last trace of free nitrate of silver, and are then to be toned by placing them one at a time face downwards in the above solution. In very cold weather this solution, like the ordinary gold toning bath, should be warmed to about 70° or 80° Fahr. The toning is very rapid. The solution given above is to be used when a black colour is wished, the toning being pushed till such colour is reached. If a warm brown is wished, it is advised that the solution be diluted with three or four times its

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* This is the platinum salt issued by the Platinotype Company for the "cold bath" process, and it can be got from them.

† Chloro-platinite of potassium	... 4 gr.
Nitric acid	2 to 3 c.c.
Water	... 1 litre

amount of water, so that the toning is sufficiently under control to stop the action when a brown colour is reached. In this case several prints are placed in the solution at a time.

The prints are to be washed, fixed, and again washed like ordinary silver prints.

Since the above was written, I have used Clark's process with the most satisfactory results. In my hands the following modified formula has worked better than Clark's original formula given above :—

Chloro-platinite of potassium ...	60 grains
Citric acid	150 ,,
Common salt...	1 ounce
Water	120 ounces*

The prints go directly from the printing frame to the toning solution without any washing. They first turn bright red, then tone with fair rapidity. The solution keeps, apparently, indefinitely, but becomes reduced in bulk from the fact that the prints enter it *dry*, and leave it *wet*. The deficiency is made up with solution mixed as above, and if the action becomes too slow a little additional platinum salt is used.

The first water used for washing after toning should have enough ammonia added to it to smell slightly.

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* Chloro-platinite of potassium ... ... 4 gr.
Citric acid ... ... 10 ,,
Common salt ... ... 30 ,,
Water ... ... 4 l tres

CHAPTER XXI.

TRANSPARENCIES—LANTERN SLIDES—ENLARGING AND REDUCING.

The particular form of print known as a transparency is a very attractive one. It differs from an ordinary print inasmuch as it is seen by transmitted, not reflected, light. It is usually on glass, and is seen by being hung up against a window, or wherever there may be a strong source of light behind it. A transparency differs from a negative only inasmuch as the shades of nature are correctly represented, instead of being reversed.

Very fair transparencies can be made on the ordinary dry plates used for negatives, especially such as are rather slow. One of these is placed behind a negative in a printing-frame, and an exposure, which may vary from five seconds to a minute, according to the density of a negative, is given at a distance of (say) three feet from the gas-burner.

Development may be either by ferrous oxalate, pyro with carbonate of soda or potash, or with hydroquinone, &c. In fact, what is said in a former chapter on the developers suitable to gelatino-bromide prints will apply also to transparencies on gelatino-bromide. It is necessary to stop development whilst the whites still remain quite pure, and to use fresh mixed "hypo" in fixing.

Gelatino-bromide plates are now specially made for transparency work. They differ from ordinary plates chiefly in being much slower. They give excellent results if a black colour only be wished.

Some time ago, gelatino-chloride plates specially prepared for the making of transparencies became an article of commerce. They give very beautiful results, a variety of tints being obtainable.

Of these plates it is necessary to say but little, as the manner of development is quite similar to that which has been treated of already, whilst the particular solutions to be used are fully described in the instructions which are issued with the plates.

In appearance, the plates are much more transparent than gelatino-bromide plates. Indeed, so transparent are they that it is often difficult to tell which side has the film on it. The chloride plates are far less sensitive than the bromide, and can consequently be worked in a much more brilliant light. In fact, almost any amount of yellow light may be admitted, or an ordinary uncovered candle may be used, if a little care be exercised in working.

The writer has always found that he required to give considerably longer exposure than that mentioned in the instructions. Undoubtedly the most convenient way of exposing is by burning a few inches of magnesium wire in front of the negative. In the writer's experience, three inches of wire is a good amount to burn, the distance at which it is held from the negative varying from eight inches to two feet, according to its density and the colour of transparency required. The longer the exposure, the developer being adapted to it, the warmer will the colour of the transparency be. It is possible to get any colour of image from a black to a claret red.

The developer used is ferrous-oxalate, ferrous-citrate, or a mixture of both. It may also be varied by the use of a

restrainer, or of a smaller or larger excess of citric acid. The ferrous-citrate gives a warmer colour than the ferrous-oxalate; and a restrainer added either in the form of chloride of sodium (common salt), or free citric acid, gives a still warmer tone, *the exposure being duly increased.*

In development, the plate should be touched by the fingers as little as possible, as chloride plates are far more liable to stain than bromide plates.

Recently *printing-out plates* have been introduced. They are printed, toned, and fixed just like printing-out paper, but that, as they are not flexible, they cannot be examined in the printing frame like paper. After some practice, however, a fair judgment of density may be made by looking through both printing-out plate and negative, unless the latter is much fogged. These plates are too slow to use but by contact. For direct enlarging, or even reducing, they are not sensitive enough.

Lantern Slides.

Slides for what used at one time to be called the "magic lantern," but what is now commonly designated by the more imposing title of the "optical lantern," are simply transparencies made of a small size to suit the optical apparatus. The usual size is 3¼ inches square. If negatives be made of this size specially for the production of the slides, the matter is a very simple one. Gelatino-bromide plates *may* be used, but gelatino-chloride are very much better.* The printing is done by contact, and development is performed precisely as for a transparency, two points being, however, specially borne in mind: first, that the high lights be kept absolutely clear; second, that the shadows be made a little less dense than would

* Collodio-bromide or "bath" collodion plates are still better, but it is beyond the scope of a book for beginners to enter into details of these processes.

be considered desirable for a transparency to be viewed direct. A slide is usually finished by placing a second piece of glass against the film side of it, and fixing the two together by black paper at the edges. "Needle" paper is the best.

When a lantern slide—or, in fact, a transparency of any kind—has to be made to a reduced scale (smaller, that is, than the negative), the camera must be used either to produce direct a reduced transparency, or to produce a reduced negative, from which transparencies can be printed in the usual way. The method of reducing will be shortly explained.

Printing-out plates are particularly applicable to the making of lantern slides when these may be made by contact.

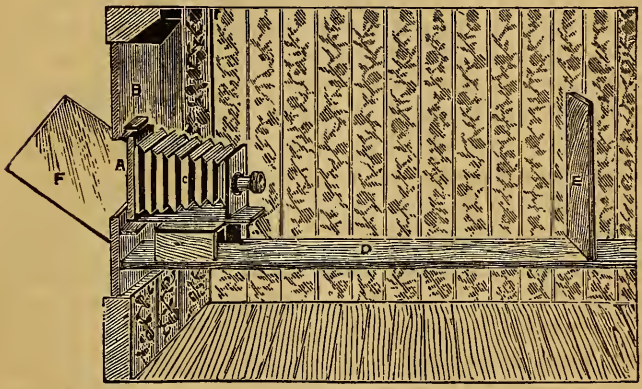
Enlarging.

The advantages of being able to make enlargements need not be insisted upon; they are self-evident. The production of enlargements was, until within the last few years, a thing rarely undertaken by an amateur; but the introduction of gelatino-bromide paper for the purpose has made enlarging so simple an affair that there is no reason why any amateur should hesitate to undertake the work.

Special appliances are made for producing enlargements. These are simply modified optical or "magic" lanterns; that is to say, they are lanterns in which a negative from which it is desired to take an enlargement takes the place of a lantern slide. A negative image is thrown and is received on an easel, to which is fixed a piece of white paper for focussing, afterwards the sensitive gelatino-bromide paper to receive the exposure. The paper is, after exposure, developed in the usual way. A good form of enlarging lantern is that known as the cantilever.

The appliance mentioned is very convenient, but it is somewhat expensive, even for enlarging from small negatives, very

expensive for enlarging from large. In a camera and lens every photographer who can darken a room, and has a shutter with a square hole made in it, has all the appliances necessary to produce enlargements of practically any size from any negative his camera will make. I here illustrate the arrangement.



A is a hole cut in the shutter B, so that the back end of the camera C may lie against it, shutting out all light. D is a board so constructed that it can hold the camera and also an easel or upright board, E, which latter must be capable of adjustment so as to be approached to, or receded from, the camera.

It is not necessary that the easel should slide. An amateur, at any rate, never needs to enlarge to a mathematically correct extent, and, as a consequence, it is sufficient if the easel E can be fixed to the board at every three, or even at every six inches. In one of the writer's former enlarging rooms this was managed with pegs in the lower edge of the easel, and holes every three inches along the board D. There was also a support at the back of the easel to keep it steady. F is a reflector consisting of a board

or other plane whitened in any way, and fixed at an angle of 45° or thereby with the horizontal. It must be of such a size that, when the camera is out of the way, an observer looking from the position occupied by the lens when the camera is in position, will not see its edges through the hole A.

If the surroundings are such as to make it possible, the board may be sloped so that the back of the camera points to the sky; no reflector is needed, and the exposure is thus shortened. Should the sun shine on the negative, several thicknesses of tissue paper may be used to diffuse the light.*

If the dark slide of the camera be of the American pattern, in which both shutters can be withdrawn, the negative to be enlarged may be fixed in the slide, which, again, may be run into its groove in the camera. If the slides be of the English pattern, a special frame of wood that will hold the negative is made to take its place, or the ground glass may be taken out and the negative be put in its place. In direct enlarging the film of the negative must be placed to the *outside*. In any case, it will be found that an image of the negative will be thrown by the lens on to the easel E, and that the distance of the easel from the camera will determine the size. The farther away the easel, the larger the image. The nearer the easel, on the other hand, the smaller will be the image; but the longer will the camera have to open, till, when negative and image are of the same size, the camera will have to be opened twice as long as when a distant object is being photographed; and the

* In an enlarging room I recently had, the sun shone thus for nearly ten hours of every day. It was before the time of the NEW LENSES, and I had to make in a few days a number of huge enlargements in which definition was of great importance. Three thicknesses of *gampi* paper was used, and several mirrors were so placed as to reflect extra light on this diffuser, a boy being employed to adjust these as the apparent motion of the sun required.

distance between the negative and the image will be four times the equivalent focus of the lens.

The rule for the distance between the lens and the easel may be here given:—

n = the number of times of enlargement.
f = the equivalent focus.
d = the distance between the lens and the easel.

$$d = (n + 1) f$$

Example:—We wish to enlarge four times with a lens 10 inches diameter.

$$d = (4 + 1)\ 10 = 5 \times 10 = 50 \text{ inches.}$$

The distance from the negative to be enlarged from and the lens is got from the following formula; this distance being called d'.

$$d' = \left(\frac{n + 1}{n}\right) f$$

Taking the same example as before,

$$d' = (\tfrac{5}{4})\ 10 = 12{\cdot}5 \text{ inches.}$$

These examples mean, that with a lens 10 inches focus, when we wish to enlarge four times—that is to say, to make our picture four times as large *each way*—we will have to extend our camera to 12½ inches, whilst we make the distance from the lens to the easel 50 inches.

Those who can readily manipulate this very simple equation will find it a great assistance in getting their apparatus approximately into position. Those who cannot, may, by the expenditure of a little time, and the use of a foot rule, effect the same object by trial and error.

In any case, it is necessary to make a final focussing by the camera screw as usual, so as to get the image quite sharp. Any lens may be used, but probably the best is one of the

rapid symmetrical or rapid rectilinear type.* A stop is used only if necessary to improve marginal definition.

I hope I have made the optical arrangement sufficiently clear. The next question is, as to what kind of a film is to receive the impression on the easel? Undoubtedly, the best thing for the beginner to use is the gelatino-bromide paper specially prepared for enlargements. This is worked exactly as described in Chapter XVII.

After focussing, it is only necessary to shut out all white light by capping the lens, to pin the sensitive paper on to the easel—the dark-room lamp being used to work by—to make an exposure, and to develop, fix, &c., as for a contact print on gelatino-bromide paper.

Regarding time of exposure, it is most difficult even to give a hint, so many factors tend to vary it. It is best to pin a small piece of paper on to the easel first, and make a test exposure, when, after development, the fragmentary enlargement may serve as some guide.

It must be borne in mind that, *other things remaining the same*, the exposure varies as the square of the distance between the lens and the film, so that it is longer the more times we wish to enlarge.

The following may serve as a hint, although it may be taken as nothing more.

Enlarging three diameters from a good negative, light good, lens the rapid symmetrical, full aperture (aperture about *f*/9), the exposure needed was thirty seconds.

I have seen beautiful results produced direct on "rapid" paper, but the exposure needed is very much longer than for gelatino-bromide paper. It is certainly no exaggeration to say that it is two or three hundred times as long.

* At the present time any of the rapid forms of the NEW LENSES is much to be preferred.

So much for the making of enlargements one at a time. If a particularly valuable picture be in the possession of the photographer, and he wish to make many enlarged copies from it, he will find the arrangement of taking them each one separately very tedious. He will find it necessary, or almost so, to make an *enlarged negative* from which to print in the ordinary way.*

Put in the fewest words possible, an enlarged negative is got in one of two ways. (1) An enlarged *transparency* is made by aid of the camera, and from this a negative is taken by contact. (2) A transparency is made by contact, and from that an enlarged negative is taken by aid of the camera.

For various reasons, optical and others, the first method, although the more expensive, is the better. I shall therefore describe it.

The process, to begin with, is precisely the same as that described for enlarging on gelatino-bromide paper, but that a large gelatino-bromide plate takes the place of the paper.† The exposure is made, as already described, and the plate is developed. The exposure must be long enough to impress all the details of the high-lights on the plate. Indeed, no part should remain absolutely transparent as for an ordinary transparency.

This plate once exposed, developed, fixed, &c., and dried, a negative is got by pressing a second plate against it, and exposing to gas-light, or lamp-light, or some such other. This last plate may be either a bromide or a chloride plate. Probably the latter will give somewhat the better result. I suppose printing-out plates would work well, but I have not tried them,

* This applies only within limits.

† Those familiar with the wet process will find it cheaper, and probably better, to use a wet plate.

having, in fact, worked none larger than lantern size. This negative may be printed from in the ordinary way.

A word on the negative best for making enlargements from. It should be a well exposed one, clear in the shadows, and on the whole tending to be *thin*. A negative that gives a hard print is next to useless for purposes of enlargement.

Reductions from Negatives.

The way of reducing negatives will almost be understood by this time. It is best, in reducing, to reverse the arrangement shown in the cut on page 189 ; to fix the negative from which the reduction is to be made in the hole, and to turn the camera round with the lens towards it. Indeed, this is the best course to pursue even in enlargements, when it is not wished to enlarge to a size greater than the dark slide will hold.

In making lantern slides, it is possible to get the transparency direct by placing a gelatino-chloride plate 3¼ inches by 3¼ inches in the slide, the negative being placed in the hole in the shutter. The exposure, however, will be considerable; probably, with a rapid landscape lens, full aperture, never less than about ten minutes.* If, therefore, it is wished to get many slides from one negative, it is best to produce a reduced negative. To do this a transparency is made by contact. This may be either on a bromide or a chloride plate ; preferably the latter. As in the case of the enlargement, care is necessary to expose long enough to get out all the details in the lighter parts.

The transparency is now placed in the hole in the shutter, the camera is adjusted so that its image is 2½ inches in its longest direction, and exposure is made either on a bromide or a chloride plate. From the negative thus produced any number of slides may be made by contact.

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* Those who can work wet plates, or collodio-bromide plates, will find that they can get excellent results with *exposures far less than this.*

CHAPTER XXII.

NOTE TO THE READER.

THERE followed here, in former editions of "Modern Photography," three chapters on the making of plates. They were written at a time when the writer was one of a band of enthusiasts who took a sort of pride in making their own plates, who kept varying their formulæ, trying to get improved results, and when they got them, or thought they had, giving any benefit there might be to the public by publishing the same through one of the comparatively few photographic societies that then existed (if financial prospects were fair), or through one or the other of the only two photographic periodicals that then existed, whose kindly proprietors—both, alas! now dead—were willing to pay certain shekels for original matter passed by the editors.

I leave out these chapters with regret, partly from a sort of "Auld Lang Syne" feeling, partly because it seems to me that the negatives I have made with my own plates are better than any I have on plates bought in the market. This is very likely pure partiality, yet I am not quite sure, for I certainly used much more silver than is commonly put into commercial plates. In spite of this, I fear the chapters would seem much out of date now, for the amateur who is willing to coat the midnig

plate after he has made the midnight emulsion the night before, and the next evening very likely to tear his hair and curse himself in his despair when only the blackest of fog comes out under the developer, appears to be a creature of the past.

It seems a pity that he does not longer exist, for the black fog was by no means always the result, and it is impossible for the mere plate-user to understand the feelings of pride and exultation of the plate-maker when an emulsion by a new formula turned out better than any before—when the test plate came up with the light-protected part a pure white; when the density seemed to come eagerly; when the gradation between these two seemed just right, and the plate turned out to be "extra-rapid"; more sensitive than anything that one could rely on buying in the open market. Then there was joy in the house, and glass was coated with the bulk of the emulsion with a tenderness and loving care that it is difficult to imagine. A really successful negative on such a plate seems a precious thing—a very child of the maker.

I quote a few words from the first of the three chapters mentioned:—

". . . the amateur will generally find it best to purchase plates from a manufacturer. He will probably find it cheaper and more satisfactory to do so than to manufacture them himself. . . . "

"Nevertheless, I believe that the photographer who makes himself acquainted with the process of the manufacture of dry plates, and knows how to make an emulsion, will have more thorough mastery of the working of them than those who have never made their own plates."

I believe this just as much as I did twenty years ago, and I say to the amateur who has enthusiasm enough, TRY IT. There are many books which now give all sufficient instructions. Notable

among them are the works of Abney and Eder. The instructions given in former editions of this book will certainly be found workable. I know that more than one commercial firm of platers have used the latter of the two formulæ given, and perhaps do so still.

CHAPTER XXIII.

ORTHOCHROMATIC OR ISOCHROMATIC PLATES.

It has been pointed out at the beginning of this book that the plates commonly used in photography are all but insensitive to the colours red and yellow. They are also but slightly sensitive to green, being, in fact, enormously more affected by the colours at the blue end of the spectrum than by any others. The result is that any objects of a red or yellow colour come out much too dark in working with ordinary plates, whilst green objects do so also, but to a less extent.

In photographing subjects that depend for their effect greatly on colour—especially paintings—the effect of this want of sensitiveness to certain colours has been very seriously felt, and for years attempts, more or less successful, have been made to produce plates more sensitive to the yellow and red rays, so as to render the colours with their true values. For some years the success has been very great, and ortho- or isochromatic plates, as they are called, are articles of commerce.

These plates are much more sensitive to the yellow, and in some cases to the red, than are ordinary plates, yet they do not give these colours with their true values unless the blues be somewhat suppressed; so that a rather long exposure can be given to thoroughly bring up the yellows and reds. This can

readily be done by photographing through a piece of very light yellow glass, or—where it is possible, as in the case of a painting—by illuminating the subject with yellow light, such as daylight passed through very light yellow glass or paper, or unmodified gas or lamp-light. Still another method is to coat one of the surfaces of the lens to be used with a film of collodion stained slightly yellow.

The vendors of orthochromatic plates will provide yellow screens.

In working orthochromatic plates, it is necessary to use only the smallest quantity of deep red-coloured light, especially till the plate has been in the developer for some little time. After this it is less sensitive, but still great caution must be used.

As I have said, orthochromatic plates are an article of commerce, and most amateurs will certainly rather buy than make them; but it is likely that any amateur who is enthusiastic enough to make his own plates will like to try "orthochromatising" also. I therefore give a description of the process. It is taken from a book that is the joint work of Mr. A. Pringle and the present writer.*

"The substances most generally used for (achromatising) gelatine plates are eosine compounds, such as the dyes known as erythrosine, rose bengal, and eosine itself, and with these is generally used an alkali—viz., ammonia. The form in which these are used is generally that of a bath applied to the coated and dried plate. . . . Every precaution must be taken to guard against fog, as the plates are rendered not only highly sensitive to yellow and orange, but are also alkaline in reaction, in which state a plate is always highly susceptible to fog, not only from light, but from every sort of noxious

* "Processes of Pure Photography"; the Scovill and Adams Co., 423, Broome Street, New York.

vapour. The light used must be of the deepest ruby colour, and, indeed, the less even of that used the better. Certain dyes also fog plates even in darkness.

"A plate should be chosen with an emulsion containing little or no silver iodide.* We have known as little as three parts of iodide per centum of bromide to nullify our attempts to get a good orthochromatic effect.

"The plate is first bathed for two minutes in a solution:—

Liquor ammonia	1 part
Water	100 parts

"Then, without washing, immerse in:—

Dye (eosine 'B,' erythrosine, or rose bengal, &c.)	1 part
Water	10,000 parts
Ammonia	100 ,,

"The most convenient way to arrive at these very dilute solutions of the dye is as follows. Make first an aqueous solution of (say)—

Erythrosine ...	1 part (1 gram, for instance)
Water ...	1,000 parts (1,000 c.c., for instance)

"This may be kept a considerable time in the dark.

"The ordinary 10 per cent. ammonia solution may be used.

"Then take—

Dye (1 : 1,000)	1 part
Ammonia (10 per cent.)	1 ,,
Water	8 parts

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* The presence of iodide in the emulsion of a plate is indicated by the *yellow* colour of the film if examined by reflected daylight, and a fair idea of the quantity of iodide present may be formed from the intensity of the yellow. I am of opinion that very few commercial plates contain as much as three per cent. of silver iodide in the emulsion.

"Some dyes useful for this purpose are insoluble in water; in these cases alcohol (absolute) may be used for the first solution:—

Dye (as cyanine)... 1 part (1 gram, for instance)
Absolute alcohol...1,000 parts (1,000 c.c., for instance)

"Some workers find difficulty in using the alcoholic solutions, as there is a marked tendency to uneven staining of the plates.

"Mr. J. B. B. Wellington, of London, has shown a way to overcome the awkward precipitation that takes place when cyanine is dissolved in water.

"Prof. C. H. Bothamley, F.I.C., F.C.S., of Leeds, has done much to elucidate the practice and principles of this process; his writings may be found in files of the *Photographic News*, 1887, and elsewhere. We mention his name simply because it has been prominently brought forward lately, and not at all to the exclusion of others, as Vogel, Eder, Ives, Abney, Schumann, &c.

"Of all the processes tried by the writers, none seems to them more satisfactory—certainly none is more simple—than that last suggested by Mr. Ives, of Philadelphia. It may be stated thus:—

"In four ounces of absolute alcohol dissolve one grain of erythrosine or cyanine. Soak the gelatine bromide plate in this for a minute. Allow to dry. Wash for a short time in running water. Dry, and use. No alkali is used. The plates keep well. The cyanine renders the plates so very sensitive, even to red rays, that these operations, as well as development, must be conducted practically in darkness. The erythrosine formula has proved in our hands eminently satisfactory, the cyanine no less so, but the precautions necessary with it are apt to be irksome."

CHAPTER XXIV.

CONCLUDING REMARKS.

I HAVE but little to say in conclusion. I have tried in this little book to give as clear and as practical instructions in the various manipulations connected with negative making and printing as possible. It must be understood, however, that few rules or instructions appertaining to photography are absolute; they are all varied by circumstances. All that can be done by written instructions is to guide the intelligence of the beginner. When he ceases to be a beginner, he should depend on his own intelligence and faculty of observation more than on any instructions.

Let the student not be discouraged by failure. Failures he is certain to have. Even the most experienced fail occasionally, the majority more often than they are willing to allow; and if they do not always succeed, it is unreasonable for the tyro to expect to do so. Nevertheless, he should aim at perfection, and should not be satisfied till he reach it. Let him remember that, at least in landscape work, no amateur need despair of reaching the highest degree of perfection. Amateurs and professionals compete continually against each other, and the former as often as not carry off the palm.

The young photographer should, from the first, exercise his faculty for observation, and note the most minute departure from received rules. There are few departments of science in which there is a wider field for investigation than in that of photography, and even an inexperienced photographer, if he observe closely, may add his mite to the mass of knowledge, which has been built up, for the most part, of such mites of observation freely given to "the brotherhood" by those who have made them. Often, a fact noticed by one comparatively inexperienced in photography may give the hint to a more experienced investigator, who may make good use of it.

Another thing to be impressed on photographers is that they should not fear to give others the benefit of their observations merely because it is possible that similar observations have been made before. It is sufficient that a fact is not generally known or appreciated to justify its publication, and the oftener it is published until it is appreciated, the better.

I have before remarked that if the beginner can get the help of a photographic friend, he will find his first labours much lightened. Let me now urge upon him that, whenever he begins to feel his way, he join, if possible, one of the numerous photographic societies there are in this country. Let him not suppose that he will meet with ridicule or contempt on account of his comparative ignorance. The writer was for some time deterred from joining a photographic society for such a reason; but on attending the first meeting all his fears were dissipated. The terrible "professional" whom he had dreaded to meet, he found to be a most kindly individual, willing—nay, apparently anxious—to give what aid he could to anyone who asked advice or assistance from him. In this respect I believe photographers are different from, and superior to, most other professional men. An amateur architect, engineer, doctor, or physician, by no means meets with the same kindly reception from professionals, at the

gatherings of their societies, that the amateur photographer does at the gatherings of societies composed chiefly of professional photographers.

Finally, I repeat the advice that the reader, while he is still unfamiliar with the various manipulations, follow to the letter the instructions contained here, or wherever else he seeks for information; but that when he begins to feel his way he trusts to his own intelligence as his great guide. If he do this, I feel sure that, from the time he first succeeds in producing by development *something* on his plate, till the time when he has arrived at such perfection that he need not hesitate to hang his pictures on the walls at photographic exhibitions side by side with those of the first photographers of the day, he will feel that every step that he makes in advance is a triumph, and will find his work—or play, as he likes to consider it—a more absorbing and delightful one than almost any other that he could have taken up.

Let him bear in mind that every operation in photography is but a means to an end (the end being the picture), and that any means that conduces to the end is permissible. Let him remember, whatever may be said to the contrary, that photography is a fine art, or, at least, is capable of being such in the hands of those who have sufficient art feeling in them. It is too common a thing to hear painting compared with photography—of course to the discredit of the latter. This is not right. The two are, in reality, not comparable; they are different in purpose and in essence. Nevertheless, photography is — silently and slowly, perhaps, yet surely — influencing painting. It is teaching painters the great lesson that without truth there can be no true art. In what I now say, do not let me be misunderstood. I do not mean to say that unless some object be rendered with strict accuracy there is no art; but I mean this, that unless an object—say a tree or a man—is

represented as it is *possible* for this object to be, then just inasmuch as it departs from this possibility it departs from true art. If a man or a horse be represented in a position that no man or horse ever was in, will be in, or could be in, then this is wrong. If a house is shown as it could not stand, or a mountain as no mountain could exist, it is wrong. In this matter painters—let them admit it or not—are being educated by photographers.

We now seldom see, even by second-rate artists, portraits of men and women showing proportions between feet, hands, head, and body such as never were; but we have only to look at portraits of fifty years ago (sometimes by eminent artists) to see that at that time things were different—that almost every man was represented as a monstrosity. In landscape painting the influence of photography is, perhaps, not so great, but it is there, and will continue to make itself more and more felt.

On the other hand, one of the highest phases of art is that which selects or combines, which, without representing a scene exactly as it is, is careful to show it as it *might* be. The power of thus selecting and combining is one that photography possesses in but a limited degree.

I would fain, to the best of my poor ability, carry the reader on to more advanced branches of the photographic art; I would with pleasure instruct him in various methods of producing permanent prints, besides the one that has been described, and in the delicate manipulation of combination printing from two or more negatives, and in the thousand and one various ways in which the end—a picture—may be produced from the photographic beginning—a negative; but all this is without my limits, and I recommend those who wish to go deeply into the matter to read diligently any of the several excellent and complete manuals and text-books on photography that exist.

I hope, and almost believe, that I have filled a little gap in photographic literature—that I have produced the first set of instructions for working modern dry plates that pre-supposed no knowledge of any other photographic process.

English Weights and Measures.

APOTHECARIES' WEIGHT.

FLUID.

60 minims = 1 fluid dram.
8 drams = 1 ounce.
20 ounces = 1 pint.

SOLID MEASURE.

20 grains	= 1 scruple	=	20 grains.
3 scruples	= 1 dram	=	60 ,,
8 drams	= 1 ounce	=	480 ,,
12 ounces	= 1 pound		

The above weights are used by photographers. Chemicals are sold by—

AVOIRDUPOIS WEIGHT.

27⅓ grains	= 1 dram	=	27⅓ grains.
16 drams	= 1 ounce	=	437½ ,,
16 ounces	= 1 pound	=	7000 ,,

French Weights and Measures.

The unit of liquid measures is a cubic centimetre, "c.c.," which measures 16·896 minims, and weighs 15·4 grains, or 1 gramme—the unit of solid measures.

1	cubic centimetre	=	17 minims (nearly).
3½	,, ,,	=	1 dram.
28⅖	,, ,,	=	1 ounce.
100	,, ,,	=	3 ounces, 4 drams, 9 minims
1000 or 1 litre	,, ,,	=	35 ounces, 1 dram, 36 minims

As a gramme is equal to 15·4323 grains, in order to convert grammes into grains, multiply the former by 15½.

MEMS.—1 minim equals 1 drop; 1 drachm, 1 teaspoonful; 2 drachms, 1 dessert spoonful; 4 drachms, 1 table spoonful. A halfpenny and threepenny piece weigh ¼ ounce; florin and sixpence, ½ ounce; 3 pennies, 1 ounce; 4 half-crowns and 1 shilling, 2 ounces; 4 half-crowns 4 florins and 2 pennies, 4 ounces. A halfpenny equals 1 inch in diameter.

DR. JANEWAY'S TABLE OF THE SOLUBILITIES OF PHOTOGRAPHIC CHEMICALS.

MADE FOR THE SOCIETY OF AMATEUR PHOTOGRAPHERS OF NEW YORK.

Abbreviations.—s. soluble; ins. insoluble; sp. sparingly; m. moderately; v. very; alm. almost; dec. decomposed.

CHEMICALS.	WATER. 59° F.	WATER. 212° F.	COLD ALCOHOL.
One part is soluble in	Parts.	Parts.	
Acid, Citric	0·75	·6	v. s.
Gallic	100	3	m. s.
Oxalic	8	1	v. s.
Pyrogallic	3·5	v. s.	v. s.
Tannic	6	v. s.	v. s.
Alum	10·5	v. s.	ins.
Chrome	10	dec.	ins.
Ammonium, Nitrate	0·5	v. s.	v. s.
Chloride	3	v. s.	sp. s.
Carbonate	4	dec.	m. s.
Sulphocyanate	v. s.	v. s.	v. s.
Bromide	1·5	0·7	sp. s.
Iodide	1	0·5	m. s.
Baryta, Nitrate	8	3	
Cadmium, Bromide	v. s.	v. s.	m. s.
Iodide	v. s.	v. s.	v. s.
Copper, Acetate	15	5	sp. s.
Sulphate	2·6	0·5	ins.
Gold, Chloride	v. s.	v. s.	v. s.
Gold and Sodium Chloride	v. s.	v. s.	m. s.
Iron, Perchloride	v. s.	v. s.	v. s.
Protosulphate	1·8	0·3	ins.
and Ammonia sulphate	3	0·8	ins.
Iodide (Ferrous)	v. s.	v. s.	sp. s.
Iodine	7000		m. s.
Kaolin	ins.	ins.	ins.
Lead, Acetate	1·8	0·5	m. s.
Chloride	v. sp.	33	ins.
Nitrate	2	0·8	ins.
Lithium, Bromide	v. s.	v. s.	m. s.
Iodide	v. s.	v. s.	m. s.
Magnesia, Nitrate	v. s.	v. s.	m. s.
Mercury, Bichloride	16	2	v. s.
Cyanide	12·8	3	ins.
Potassium, Acetate	0·4	v. s.	v. s.

CHEMICALS.	WATER. 59° F.	WATER. 212° F.	COLD ALCOHOL.
One part is soluble in	Parts.	Parts.	
Potassium, Bicarbonate	3·2	dec.	ins.
Bichromate	10	1·5	ins.
Bromide	1·6	1	sp. s.
Carbonate	1	0·7	ins.
Cyanide	2	1	m. s.
Ferricyanide	3·8	2	ins.
Ferrocyanide	4	2	ins.
Nitrate	4	0·4	ins.
Iodide	0·8	0·5	m. s.
Oxalate	3	v. s.	ins.
Permanganate	20	3	ins.
Sulphate	9	4	ins.
Sulphite	4	5	sp. s.
Sulphuret	2	1	sp. s.
Silver, Nitrate	0·8	0·4	m. s.
Oxide	v. sp. s.	v. sp. s	ins.
Sodium, Acetate	3	1	m. s.
Bromide	1·2	0·5	m. s.
Bicarbonate	12	dec.	ins.
Carbonate	1·6	0·25	ins.
Citrate	v. s.	v. s.	sp. s.
Hyposulphite	1	v. s.	ins.
Iodide	0·6	0·3	m. s.
Nitrate	1·3	0·6	sp. s.
Phosphate	6	2	ins.
Pyrophosphate	12	1·1	ins.
Sulphite	4	0·9	sp. s.
Sulphate	2·8	0·4	ins.
Tungstate	4·0	2·0	ins.
Strontia, Chloride	1·88	v. s.	sp. s.
Uranium, Nitrate	v. s.	v. s.	m. s.
Zinc, Iodide	v. s.	v. s.	m. s.
Bromide	v. s.	v. s.	m. s.
Chloride	0·33	v. s.	v. s.

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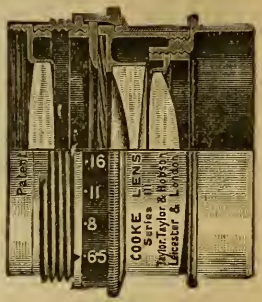

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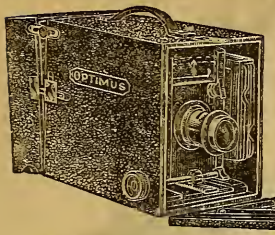

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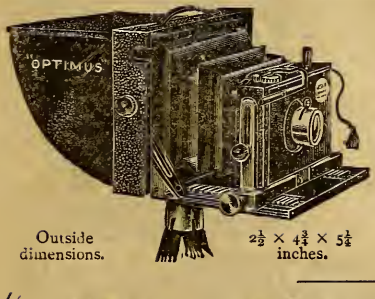

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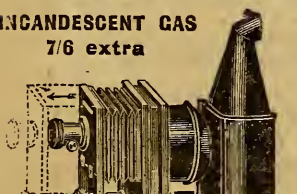

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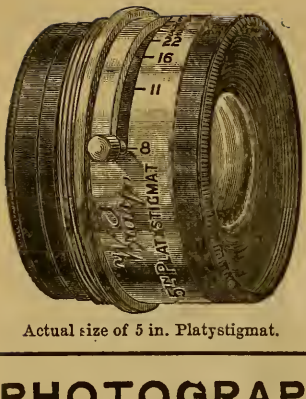

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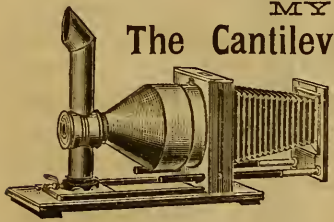

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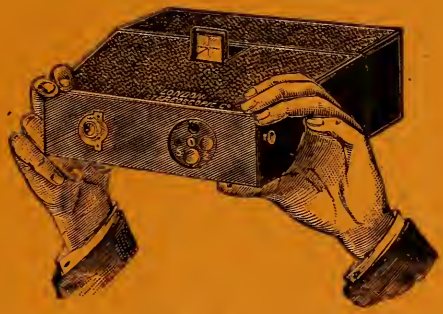

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